15 Cents | DECEMBER 1906 | $1.00 a Year

PUBLIC LIBRARY
OF THE
CITY OF DETROIT.

THE FOUNDRY

THE PENTON
PUBLISHING COMPANY.

Cleveland
Boston
New York
Philadelphia
Chicago
Cincinnati
Pittsburg
Duluth

Here's to You

To you who not only want to do big things, but have the courage to do them.

To you who are marching so swiftly in the race for supremacy that their competitors can not step upon their heels.

To you who are progressive enough to know that "Obermayer's" goods will surely help you "hit the pace" and keep ahead of the procession.

To you who know us and like us, and you who don't like us because you don't know us.

To everybody, here's luck and good wishes for the coming year.

Here's to You

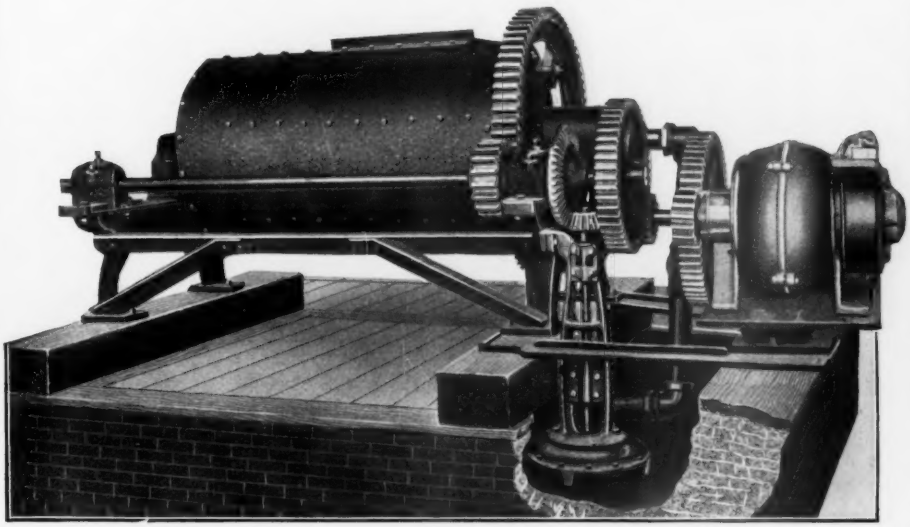
EVERYTHING YOU NEED IN YOUR FOUNDRY

The S. Obermayer Co.

CINCINNATI CHICAGO PITTSBURG

INCREASE YOUR DIVIDENDS

We know of foundries that had old Cinder heaps. They put in our patent WATER CINDER MILL, and cleared up over $5000.00 in a year's run. See if we cannot help you. See if you have not a gold mine.



The above cut is one of our Motor driven Cinder Mills.
We build both Motor and belt driven Mills.

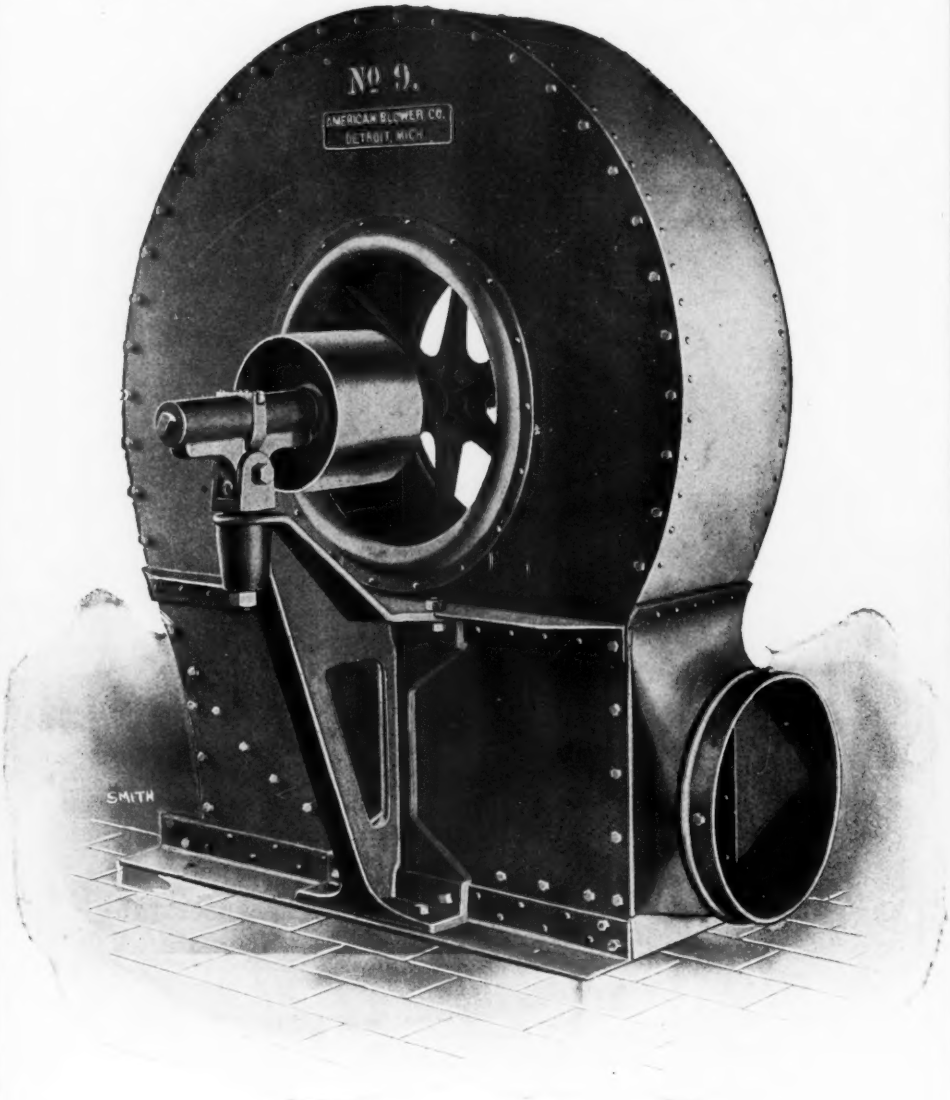
THE W. W. SLY MFG. CO.

Cleveland, O.

Manufacturers of Foundry Appliances

Send for our catalog if you have not received a copy.

"A B C"
STEEL PRESSURE BLOWER



All parts of this Blower are steel plate, except the bearings and brackets, shaft, hub and pulley. It is indestructible, stiff, tight, smooth and handsome.

The bearings are long, self-oiling, self-aligning in every direction, and finely finished.

The wheel is given a running balance, being perfectly smooth and quiet in operation.

These points are elaborated in Catalogue No. 190. Shall we send it to you?

AMERICAN BLOWER CO.,
DETROIT
New York Chicago Atlanta London

In the Sturtevant High Pressure Blower

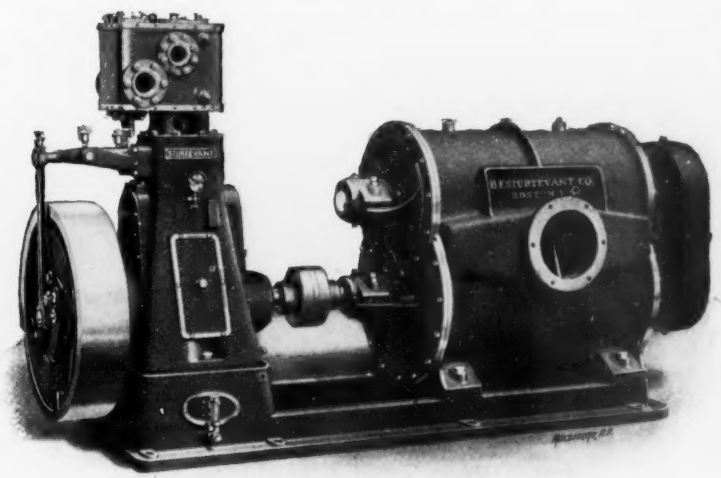
there is

No careful and frequent adjustment of bearings necessary to keep impellers trued up.

No loss of efficiency through rubbing of impellers; because they never touch.

No tramsmission of heavy load through gearing; because the idler has no work to do.

Send for Bulletin 127.



B. F. STURTEVANT COMPANY

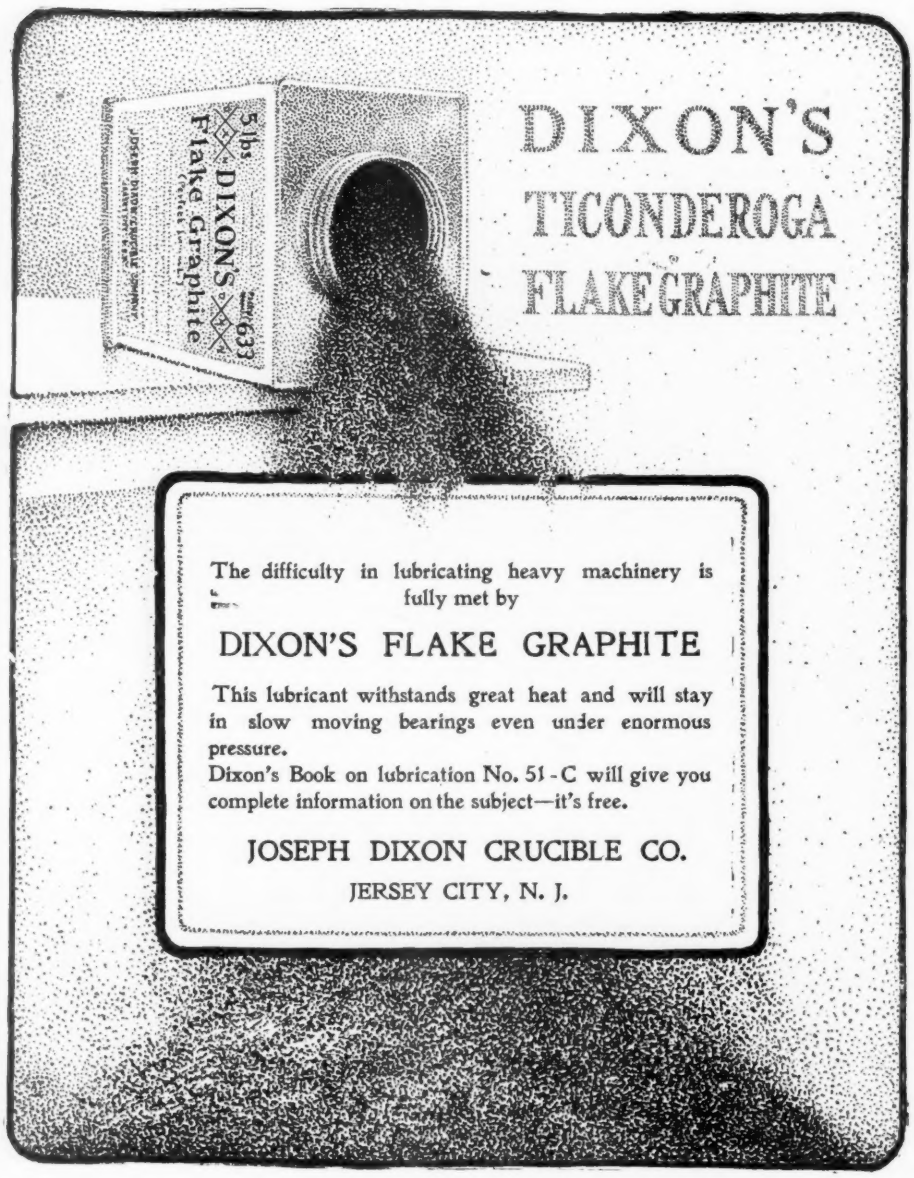
BOSTON, MASS.

General Office and Works, Hyde Park, Mass.

New York **Philadelphia** **Chicago** **London**

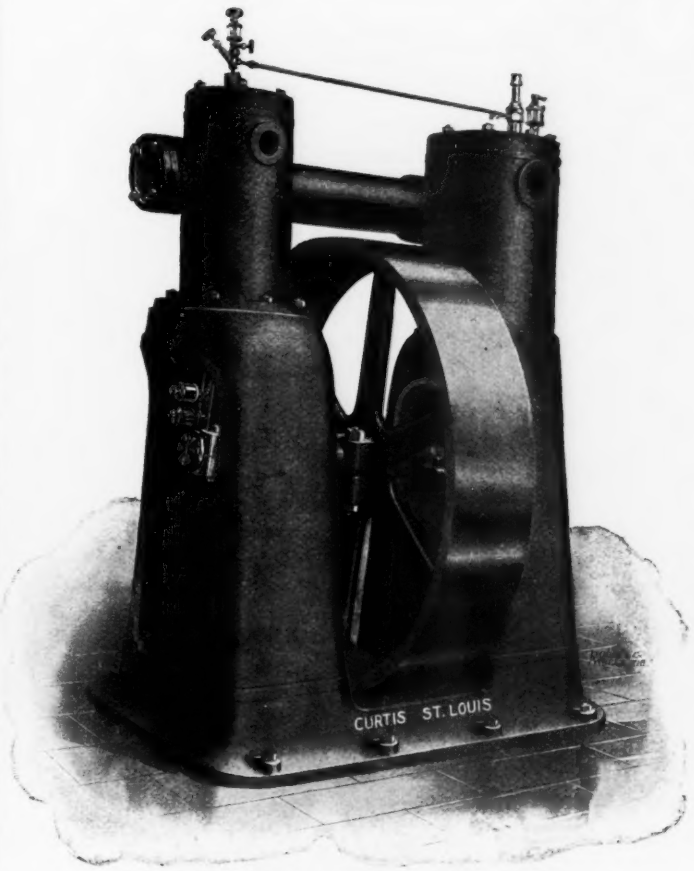
Designers and Builders of Heating, Ventilating, Drying and Mechanical Draft Apparatus; Fans, Blowers and Exhausters; Steam Engines, Electric Motors and Generating Sets; Fuel Economizers; Forges, Exhaust Heads, Steam Traps, Etc.

606


5 lbs.
DIXON'S
Flake Graphite
No. 633
DIXON'S
TICONDEROGA
FLAKE GRAPHITE
The difficulty in lubricating heavy machinery is fully met by
DIXON'S FLAKE GRAPHITE
This lubricant withstands great heat and will stay in slow moving bearings even under enormous pressure.
Dixon's Book on lubrication No. 51-C will give you complete information on the subject—it's free.
JOSEPH DIXON CRUCIBLE CO.
JERSEY CITY, N. J.

THE CURTIS TYPE

Automatic Air Compressors



13-8 x 12 Doub'e Stage Compressor. 150 revolutions.
138 cubic feet per minute

all are VERTICAL and SINGLE ACTING

both SINGLE and DOUBLE STAGE

BELT and ELECTRIC DRIVEN

20 PER CENT SAVING IN POWER

over the ordinary type of double acting single stage

CURTIS & CO. MANUFACTURING CO.

ST. LOUIS

Baird Machinery Co., Pittsburg

A. E. Hoermann, No. 41 Park Row, New York.
Hill, Clark & Co., Boston

C. E. Mills, Specialist

REFERENCES GIVEN TO THE LARGEST FOUNDRIES IN THE COUNTRY.

MILLS DRY CORE COMPOUND

No. 1 for heavy or ordinary Core-making No. 2 for any work, but is especially adapted for Malleable Iron, Brass and Steel Foundries. It goes three times as far as Rosin, and twice as far as Flour. No blow and no absorption of moisture.

SYRACUSE X-XX-XXX CORE OILS

Perfect adaptation for all work. Best Core Oil on the market.

SYRACUSE LADELENE COMPOUND

Facing, Core Wash, Lining for Ladles, Cupolas, Locomotive and Stationery Fire Boxes, Gas Work, etc.

Half the cost making cores with our MILLS DRY CORE COMPOUND.

We have Agencies in the following cities, who carry our goods in stock, whose territories are as specified:

GOLDEN RULE OIL CO., 171 Washington St., Chicago, Ill.
Agents, Cooke County, Illinois, and State of Iowa.

HILL & GRIFFITH CO., Cincinnati, O.
Southern Agents.

WHITEHEAD BROS. CO., Providence, R. I.
Agents for New England.

THE DOMINION FOUNDRY SUPPLY CO., Ltd., Agents for Canada.
Offices and Warehouses—122 Wellington St., Toronto, Ont.
and 47 Murray St., Montreal, Que.

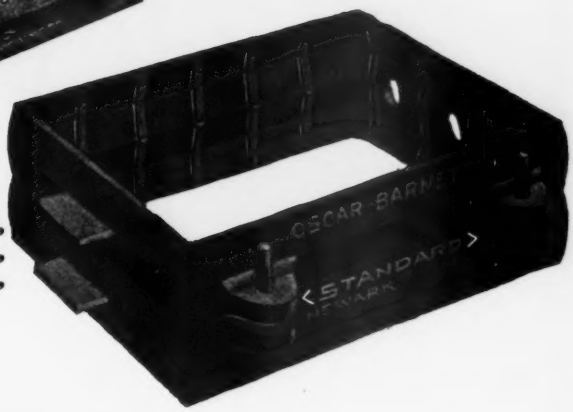
C. E. MILLS OIL CO.

Sole Manufacturers

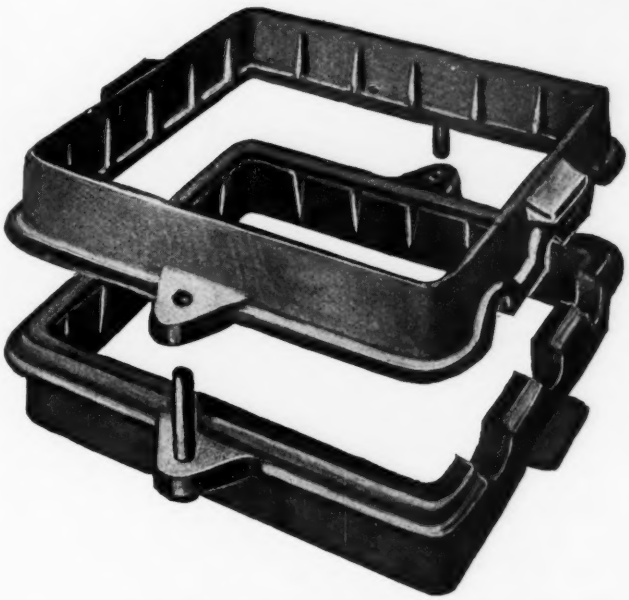
SYRACUSE, N. Y.

Brass Molders' Flasks

Of Every Style and Size



Furnaces, Drying Stoves, Spill Troughs, Clamps, Boards, Tongs, Crucibles, etc., etc.



All our flasks interchange with any of same size made by us.

Our own foundries ensure prompt shipments.

THE OSCAR BARNETT <STANDARD> FLASK IS MADE ONLY BY

Oscar Barnett Foundry Co.

Founded 1845 **NEWARK, N. J., U.S.A.**

Have you enough Good Iron?

The consumption of iron during 1907 promises to exceed all previous records. Choice brands of foundry irons will continue to be scarce. Avoid the off-grade concession and place quality before quantity. Remember our guarantee---QUALITY (soft, strong and uniform) in all shipments of CHERRY VALLEY IRON---the iron with all the features a good foundry iron should possess. It makes an ideal mixture for machinery castings, as a trial will prove. The trial is all we want---all we need, to secure a foothold on your future business.

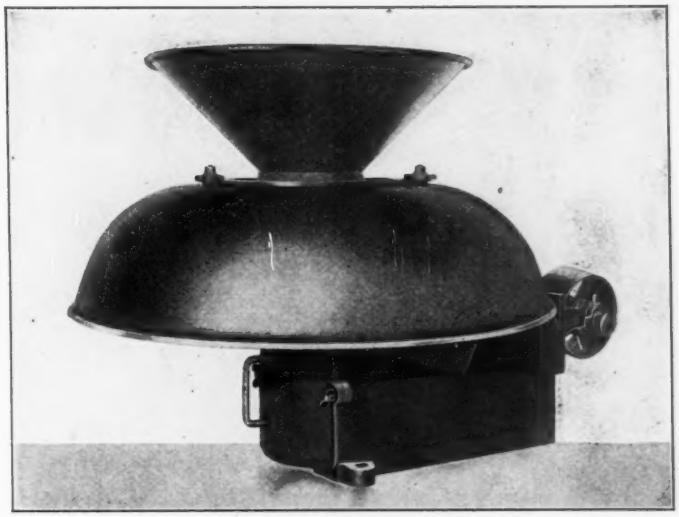
THE CHERRY VALLEY IRON CO.
Pittsburg

William Sellers & Co., Incorp.

PHILADELPHIA, PA.

Modern Machine Tools

We illustrate hereunder one of our specialties for Foundry use, which has proved very satisfactory and profitable in service.



Centrifugal Sand Mixing Machine

We have furnished these machines to many users and shall be pleased to supply full particulars upon application.

TRAVELING CRANES JIB CRANES

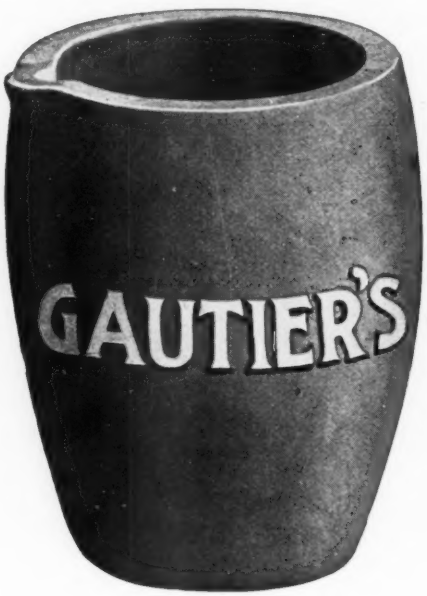
SHOP TURNTABLES

Improved Injectors for Boiler Service

SHAFTS, HANGERS, PULLEYS, COUPLINGS, Etc.

FOR THE TRANSMISSION OF POWER.

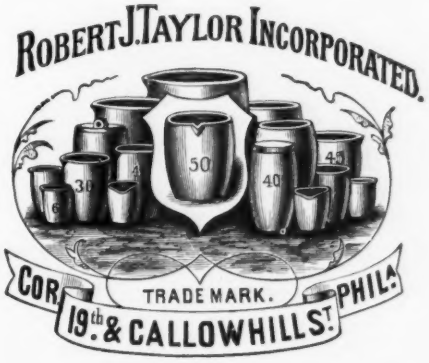
No crucible is better made
or gives longer wear than



For over fifty years Brass Founders everywhere have backed us up in this statement.

J. H. Gautier & Co.

JERSEY CITY, N. J.



This trade mark stands for the acme of crucible uniformity.

Careful selection and analyzing each brand of our material, is *one* reason why the "Taylor" Crucibles give uniform satisfaction.

A trial will convince you.

Robert J. Taylor, Incorporated

1900 to 1916 Callowhill Street

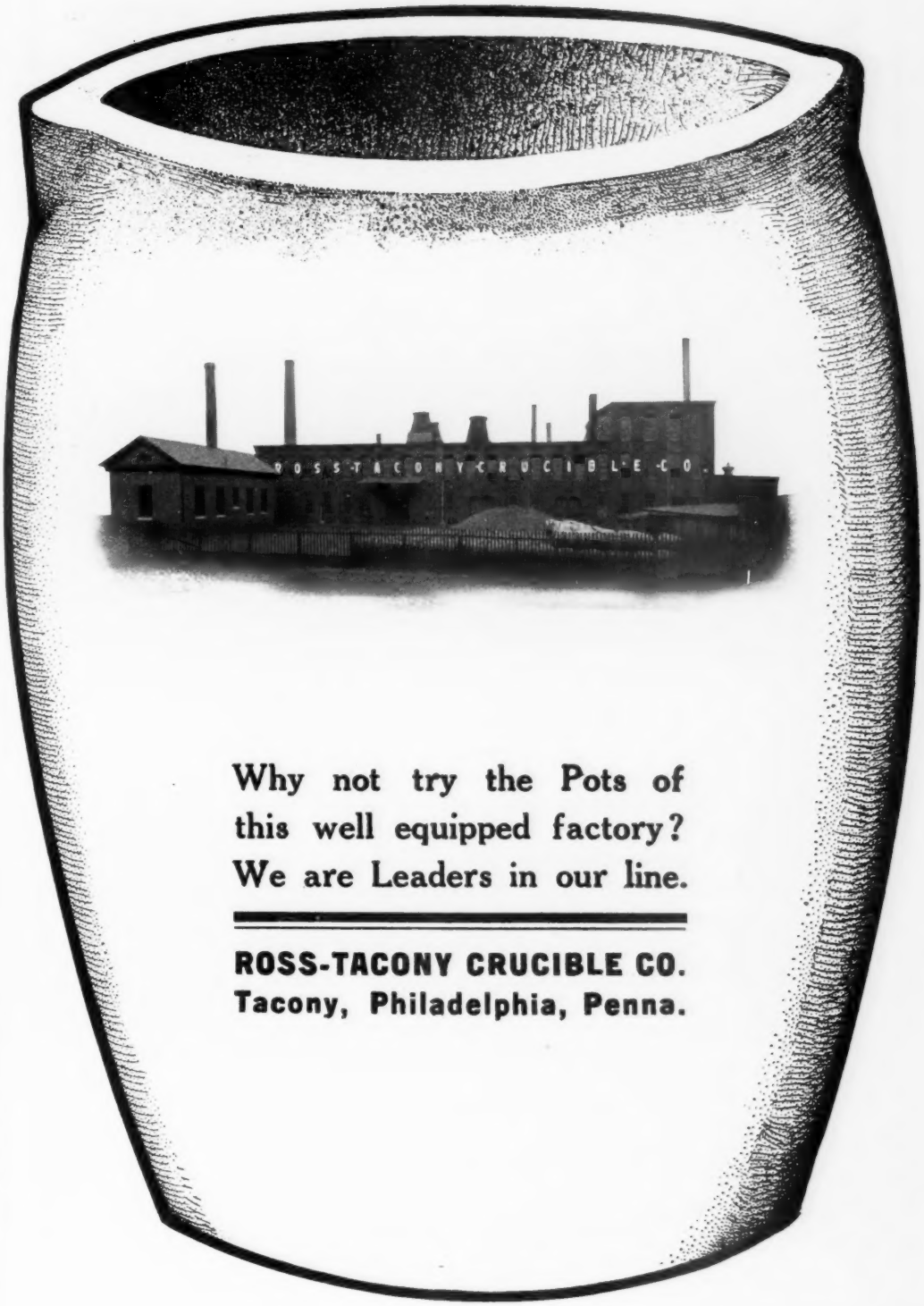
PHILADELPHIA, PA.

"Under cover, from start to finish" is more than a phrase—applied to McCullough-Dalzell Crucibles, it's a letter of introduction.

Get acquainted—write for prices to-day.

McCullough-Dalzell Crucible Co.

Pittsburgh
Pa.

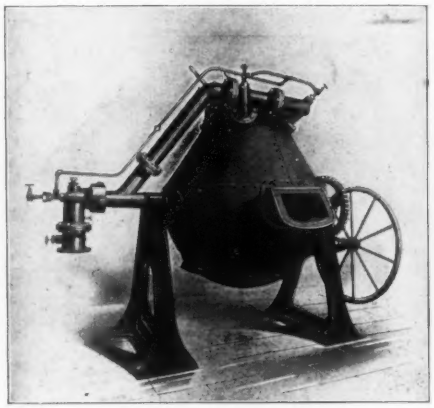


Why not try the Pots of this well equipped factory? We are Leaders in our line.

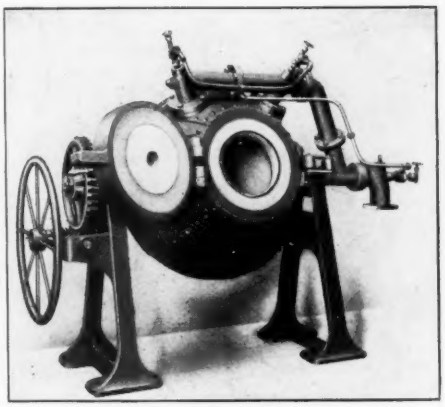
ROSS-TACONY CRUCIBLE CO.
Tacony, Philadelphia, Penna.

Schwartz Melting and Refining FURNACE

Simplicity—Durability



Melting position



Charging position

Best and cheapest method for melting brass, copper, bronze, gray iron and malleable iron.

Produces better metal and perfect castings. Less loss in shrinkage and no ashes. No crucibles are required.

Made in sizes from 100 lbs. to 10,000 lbs. capacity.

Fuel used: crude oil, fuel oil or gas.

SCAN THIS LIST OF SOME USERS

A recommendation in itself

J. B. Clow & Son
Crane Co.
Manning, Maxwell & Moore
Hewitt Mfg. Co.
Atlantic Brass Co.
Otis Elevator Co.
U. S. Navy Yards
General Electric Co.
Roe Steel Co., Middlesex, Eng.
Ludlow Valve Co.
Erie R. R.
D. & R. G. R. R.
C. R. I. & P. R. R.
L. & N. R. R.
Gr. Northern R. R.
Smeeth Copper Co.
Best Mfg. Co.
International Steam Pump Co.
American Locomotive Co.
Magnus Metal Co.
Westinghouse Electric Co.
Westinghouse Air Brake Co.
Newport News Shipbuilding Co.
British Admiralty, Chatham, Eng.
Nathan Mfg. Co.
C. B. & Q. R. R.
A. T. & S. Fe R. R.
Seaboard Air Line
N. & W. R. R.
B. & M. R. R.

"Sold on guaranteed results"

Write for new catalogue.

The Hawley Down Draft Furnace Co.

CHICAGO U. S. A. NEW YORK

We cordially invite the representative Brass Foundry interests of the country to a complete investigation of the advantages and merits of

The "Steele-Harvey"
CRUCIBLE BRASS MELTING FURNACE

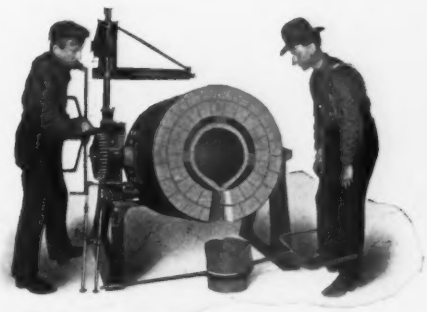
over the old coke or coal method.

Our experience and knowledge of the interests of the Foundry has been based upon an experience commencing with the old way, and developing by degrees to the present, in connection with Oil or Natural Gas and Air. We do not claim **impossible** or **extraordinary** advances, but a development of the method of melting, which is **clean, economical, labor saving,** above ground, **no ashes,** or **waste** of metal therein, a **reduction** in **cost** of fuel, using that only **which is necessary to melt** a given quantity of metal, **one** furnace doing what **3** similar coke crucibles formerly accomplished. An honest machine, which if purchased will economize for cost value within a short time, **rapidity** of **melting**—reduction in **loss**—and extension in life of crucible—maintaining a **high quality** of **metal**

Our Standard

(Patented in the United States and all foreign countries.)

IN MELTING POSITION



IN POURING POSITION

When you want it—"**It is there with the goods.**" **Do not hesitate,** but request one on **trial** and **approval,** and acceptance when satisfactorily demonstrated by our representative. On account of the enormous demand we have doubled our plant capacity and are in position to ship within 24 hours of receipt of order.

Built for capacities from **120** to **1,500** lbs. **per heat.**

Don't delay—"the other fellow will get ahead."

Write for Catalog.

The Monarch Engineering & Mfg. Co.

BALTIMORE, MD., U. S. A.

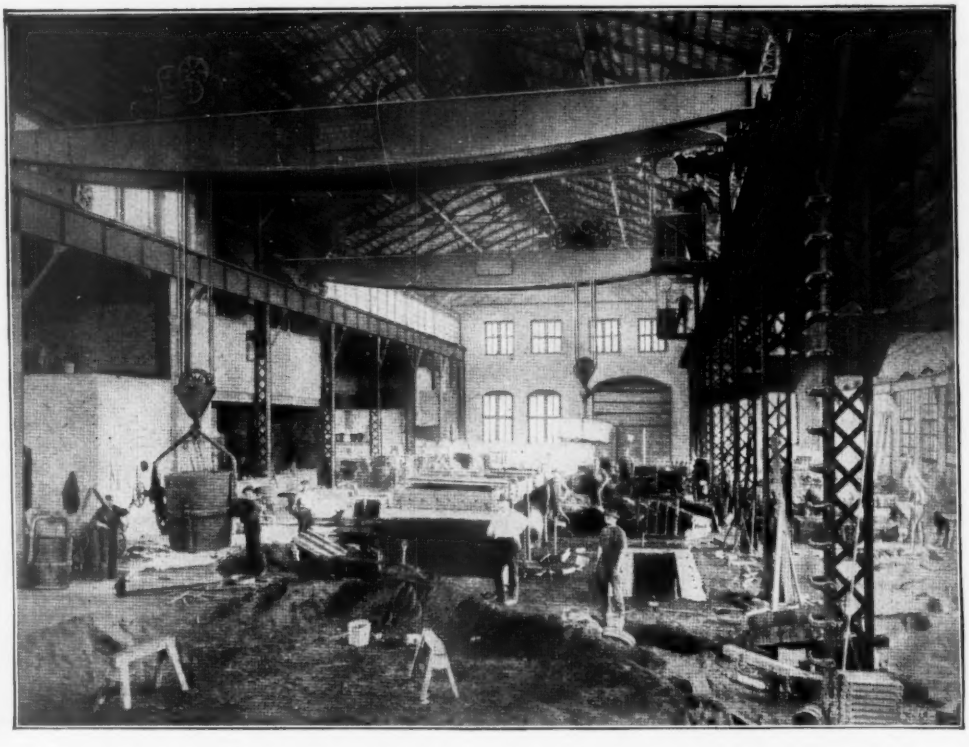
Works: Curtis Bay, Md.

EUROPEAN DEPOT—J. W. Jackman & Co., Ltd., "Caxton House," Westminster, London.

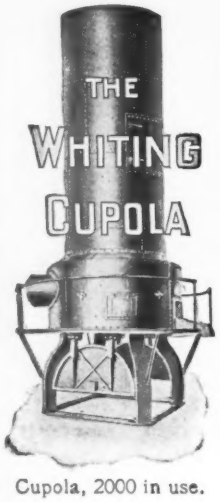
WHITING FOUNDRY EQUIPMENT CO.

General Office and Works, HARVEY, ILL., U. S. A. (Chicago Suburb)

Engineers Designers Manufacturers



Two Three-Motor Electric Traveling Cranes, capacity twenty tons. Bates Machine Co., Joliet, Ill.



Cupola, 2000 in use.

ELECTRIC TRAVELERS
CRANES OF ALL TYPES

Cupolas and **Machinery** for **Complete equipment** of **Foundry Plants. Contracts taken covering buildings** and **entire Installations. Inquiries Solicited.**

Have you our Catalogs? If not, send for them. Tell us about your Foundry Plans—we may be able to assist you.

THE FOUNDRY

Vol. 29, No. 4. CLEVELAND, OHIO, DECEMBER, 1906. Whole No. 172

A New Line of Molding Machine Practice

Even Americans, who pride themselves on being the most versatile nation on earth, are liable to fall into the error of believing that their way is the only way and the best way to accomplish any particular task. When the same task is given to several bright individuals to perform, each is sure to have some good points in his method of solving the problem and in many cases by comparing notes it would be found that each has valuable material which it would pay others to use. No one molding machine can fill the entire field. Each has its special field, though some classes or types are of far wider application than others. While we have been priding ourselves in this country that we were making the most rapid progress in molding machines, we find that rapid progress is also being made in other countries and the following is a description of some of the latest developments in French machines, which is given practically in the words of the inventor of the process, Ph. Bonvillain, of Ph. Bonvillain & E. Ronceray, Ingenieurs, 9 & 11 Rue des Envierges, Paris, France.

There have been so many styles of molding machines put on the market that it seems that there is hardly room for a new one. When I say a "new molding machine," it is a mistake, for it is really a new line of molding machines and processes that I intend to present to the readers of THE FOUNDRY. The molding machines used in the United States can be divided roughly into three classes.

Those worked entirely by hand.

Those operated entirely by compressed air.

Those operated partially by compressed air and partially by hand.

In the first class we have the old roll-over type machine, the hand squeezer, and the well-known hand-ramming, stripping plate machine.

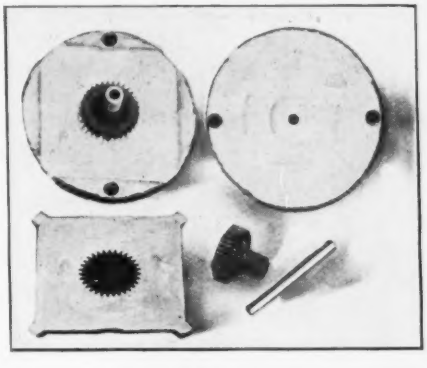


FIG. 1.

The second class comprises very few machines, for even when the pattern is rammed by compressed air it is usually drawn by hand.

The last class includes the majority of the machines using compressed air.

A roll-over machine is in reality more of a jig than a machine. When the castings have been properly designed, with their parting lines on a flat or nearly flat surface, wooden patterns may be used on a machine of this class and the fitting up of the patterns is not expensive. Though the makers claim that ordinary flasks can be used in most cases it pays to have flasks specially machined. A ma-

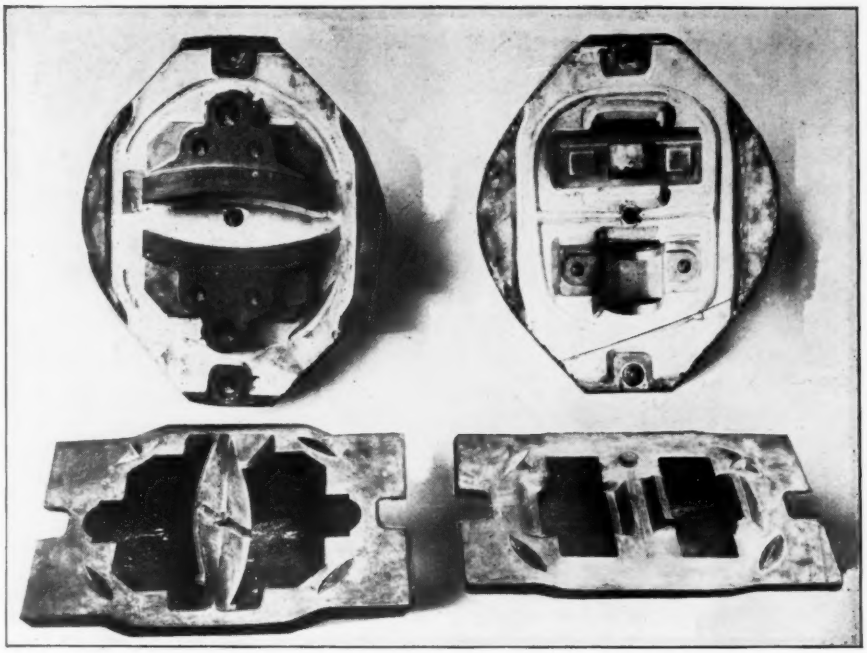


FIG. 2.

chine of this type is slow in operation and is used only for special classes of work.

The hand-ramming, stripping plate machine is very extensively used in the United States, the molds requiring little or no patching, on account of the fact that the sand is well-supported during the drawing of the pattern from the stripping plate. A ma-

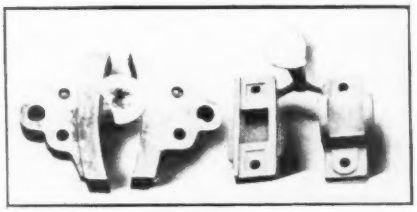


FIG. 3.

chine of this type is not a complicated one, though the bearings are liable to become quickly worn by sand falling into them. The cost of using such a machine is found in the fitting up of the pattern plate, for it requires an expensive stripping plate for each pattern. In cases where the parting line is not a flat surface the cost is very greatly increased. In fact, these machines are confined largely to the production of special castings which are turned out in large quantities. In many cases the machine is fitted up with a pattern and stripping plate for the manufacture of but a single casting.

The machines operated entirely by compressed air are not numerous. In machines of this type when the pattern is drawn by power and no stripping plate is used, the sand tends to break away and the use of the shaker or vibrator has been found necessary.

There are different ways of ramming sand by power. The most common is to put the pattern plate and flasks on a table mounted upon a ram worked by compressed air. A beam is fixed above to which is attached a piece of about the inside dimensions of the flask. The ramming is then accomplished by giving two or three blows against the ramming block supported over the flask. This operation can be accomplished very quickly, but the hardness of the sand can not

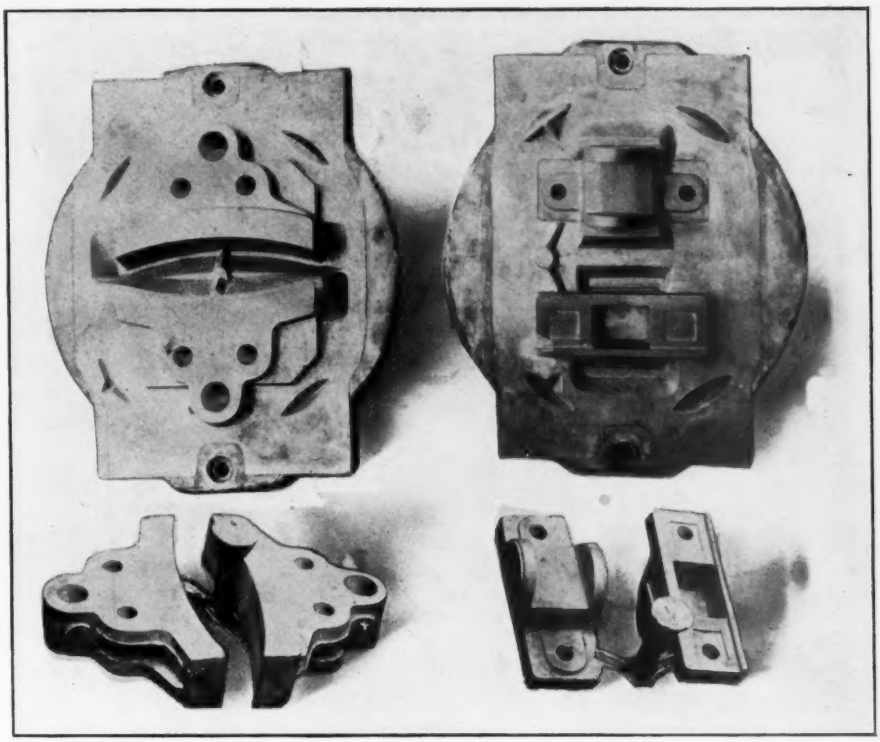


FIG. 5.

be regulated and the severe shocks repeated continuously make the machine very costly to keep in good working order. The pattern plates have to be very strong, also all other appliances used, including the flasks.

Though the various types of machines used in the United States are already numerous, it seems that there is really an opening for a universal machine, accompanied by a carefully designed system of making pattern plates. This is especially true in the case of jobbing foundries receiving orders for from 50 to 100 castings or for those making intricate castings which cannot be molded on the machines now in use. The Universal system of molding, as it has been called, from its capabilities, is in no sense inferior to that developed in connection with other machines on the market. All jobs capable of being made on other machines can also be made on the Universal machines as quickly or quicker. In addition, any casting which is within its capacity and required in numbers of fifty or more, can be pro-

FIG. 4.

duced to advantage. The more difficult the pieces are the greater will be

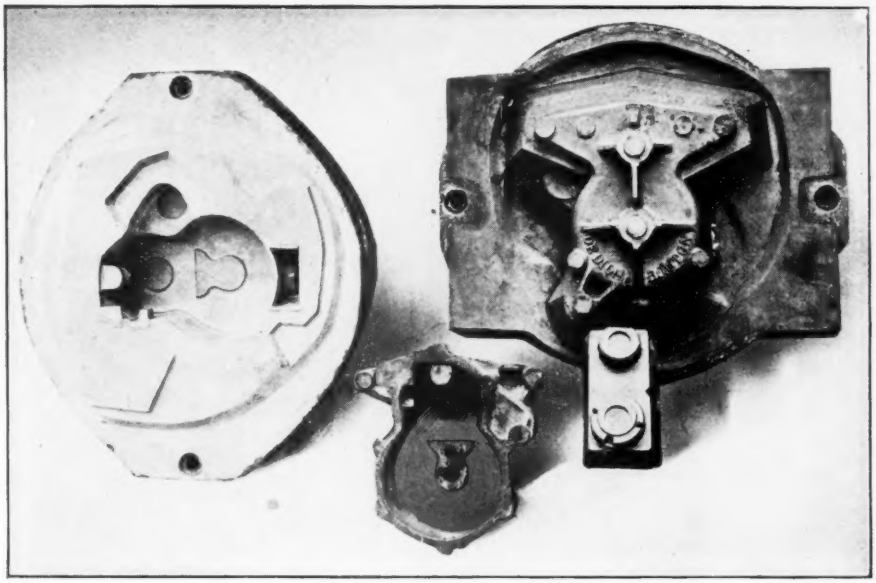


FIG. 6.

the saving by using the Universal molding process.

Operating Agent.

It is a very strange fact that few, if any, molding machines used in America are worked by any other agents than compressed air. This is the worst agent and the most expensive

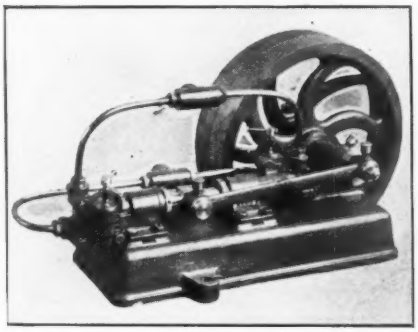


FIG. 7.

one which can be adapted for operating a molding machine. The best agent is water under pressure, as it gives a smooth, steady motion for ramming as well as for drawing the pattern.

The ramming of all molds can not be accomplished entirely by power, as in all cases except on flat patterns, some work has to be done by hand. When the castings have projections or pockets, the sand cannot be expected to be hard in those parts except in cases where some special provision is made or some hand work is done. All claims that a machine does all of the ramming in all cases are simply bluffs and every practical man is aware of this fact.

The system of ramming by giving a series of blows upon a frame supporting the pattern plate and the flask by throwing it against a fixed piece is a very crude means for hardening or packing sand. A steady pressure applied on the mold is more apt to give the proper hardness that must differ for each kind of mold and for each part of the mold. All of the Universal machines are provided with pressure gauges to enable the operator to regulate the actual pressure in the cylinder according to the size of the flask, the material to be poured and the shape of the mold. In an article of this character we cannot go into all of the details of perfect ramming, but all practical men know how it varies

with different conditions of practice.

The drawing of patterns requires a steady, gentle motion that cannot be obtained by an elastic fluid, such as compressed air. This is probably the chief reason why most of the machines using compressed air are arranged for hand drawing. If a little time can be saved by power ramming it will be found that a great saving can also be made by a perfect system of drawing the patterns so as to leave little or no patching to be done by hand in the completion of the mold. It takes a comparatively short time to ram a mold, but if the sand breaks in drawing, the mending of the molds means a loss of time considerably greater than the difference in time between hand and power ramming. It is on this account that the Universal system has been devised for saving all of this patching work. This is accomplished by giving especial care to the arrangement of the pattern, stripping plates, and the drawing arrangements of the machine itself. The care expended upon this machine has resulted in doing away with practically all patching and also has effected a considerable saving by enabling the machine to produce the majority of the vertical cores in green sand.

Examples of Work.

Especial equipment necessary for producing the combined spur and bevel gear shown in Fig. 1 is illustrated in the same figure and is composed of two pattern plates, a stripping plate and a stool. The stool is shown at the right, below one of the pattern plates and consists of a cylindrical bar used for pushing the core up as the mold is removed from the pattern. The core is made in halves, one-half in the cope and the other in the drag, the two parts meeting in the center of the mold. Other examples of work accomplished by this system are shown in Figs. 2, 3 and 4. At the left of Fig. 2 are shown the pattern plate and stripping plate for producing a railway brake shoe and at the right of Fig. 2 the pattern plate and the stripping plate for a special box. The castings from these two sets of patterns and plates are shown in Fig. 3, while Fig. 4 shows one-half of the mold, with the vertical cores in place. It will be noticed that the stripping plate used for the brake shoe is very irregular in its outline and departs a long way from a plane surface.

A set of pattern plates and the casting for a railway axle box and for another type of brake shoe are shown in Fig. 5. It will be noticed that in the case of the box all of the internal cores and the cores for the bolt holes are made upon the machine, while in the case of the brake shoe the three core holes in each shoe are also made upon the machine.

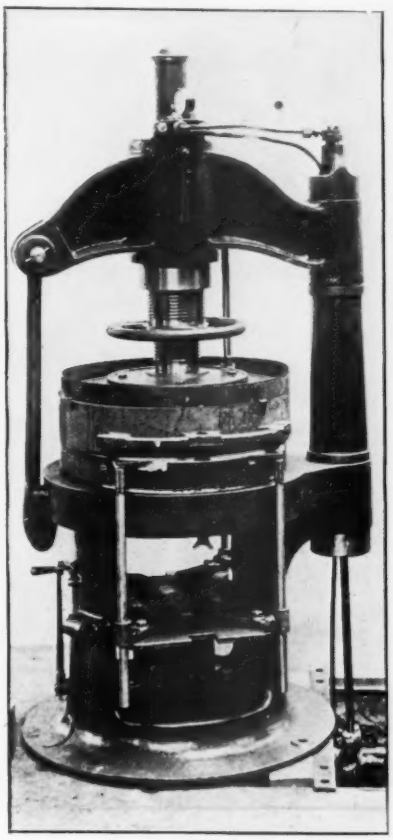


FIG. 8.

The same system is also applied to much more complicated work and a good example of this class is shown in Fig. 6, which illustrates the produc-

tion of an aluminum casting for the De Dion-Bouton motor cars. It will be noticed that the inside of the casting is formed by a core which is made entirely upon the machine, the projections being obtained by detachable pieces which are drawn in by hand after the main portion of the pattern has been withdrawn.

From the examples given it will be seen that by using a steady water pressure very satisfactory work may be obtained and a great saving accomplished where the work is properly arranged. Another very marked saving is in the power required to operate the machines. To give a blow of 12 tons with 100 pounds of compressed air and a stroke of 8 inches requires 1¼ cubic feet of compressed air, and for three blows will require 3¾ cubic feet for a flask, that is, about 30 cubic feet of free air. If we admit that the production is 30 flasks in an hour, it will require a compressor capacity of 30 x 30 divided by 60, which equals 15 cubic feet of free air per minute, and if we do not count the losses in piping it will require from 3 to 4 horsepower to operate one molding machine.

When using water pressure at 750 pounds per square inch a pressure of 12 tons is obtained with a ram 7 inches in diameter, the stroke being about 2 inches. The drawing of the pattern is then accomplished by a ram 3½ inches in diameter, having an average stroke of 6 inches. This means the consumption of about half a gallon of water per flask, that is, 15 gallons an hour, or theoretically, 1-10 of one horsepower. From this it can be seen that the economy in the use of water is a factor which should not be neglected and it must also be seen

FIG. 9.

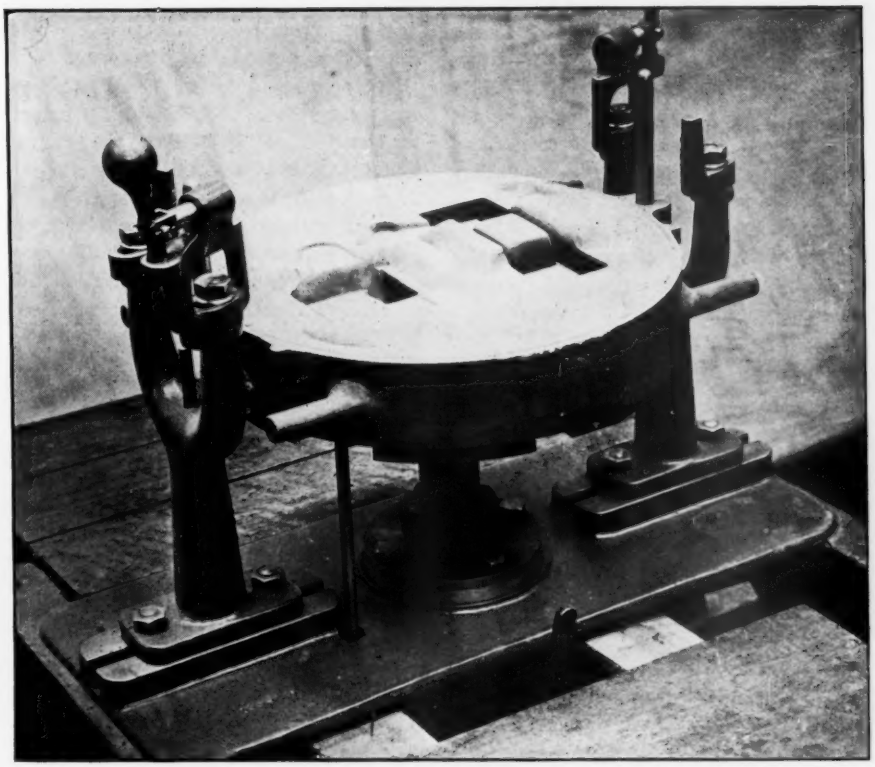


FIG. 10.

that an additional economy will be found in the advantage arising from the fact that hydraulic plants can be maintained for far less money than compressor plants.

A small double-acting pump for supplying water at high pressure is shown in Fig. 7. This was designed especially for use in connection with molding machines. Pumps of a similar style, but single-acting, are also furnished. A single-acting pump is sufficient to operate from 3 to 6 machines working on an average line of work, while a double-acting pump will take care of 8 to 12 machines.

It is a well-known fact that any equipment about a foundry is liable to be neglected, and on this account pumps certainly have advantages over air compressors. The valves in the style of pumps shown are made very accessible. The piping connections are not made to the valve box, as usual, but to the pump body proper and the parts so arranged as to bring water to the solid part of the pump body, pass it through the suction, the cylinder, the pressure valve, and out into the high pressure pipe. With this construction, if anything goes wrong in the valve box it is not necessary to lose any time on account of a lengthy shut down for repairs, for the valve box can simply be removed and replaced by a new one, leaving the injured part to be repaired while the plant is in continuous operation. The pump is so constructed that the valve body can be set in either a horizontal or vertical position, permitting the pump to be mounted horizontally as shown or in a vertical position. It will also be noticed that the lubrication is by means of grease cups. A single-acting pump requires ½ to ¾ horsepower, while a double-acting pump requires 1 to 1½ horsepower. Of course it is necessary to use hydraulic

accumulators, but these are of the simplest possible design.

The Molding Machine.

The design of the Universal molding machine is very different from that of the other molding machines generally found on the market. It is the result of long experience in machine molding where nearly all possible classes of work have to be made, and its introduction marks a considerable improvement in this branch of the foundry business. Though this machine can use ordinary pattern plates, it is more especially adapted to the use of a patent improved process for making pattern and stripping plates. The use of this complete system is revolutionizing foundry methods in the countries where it has been adopted.

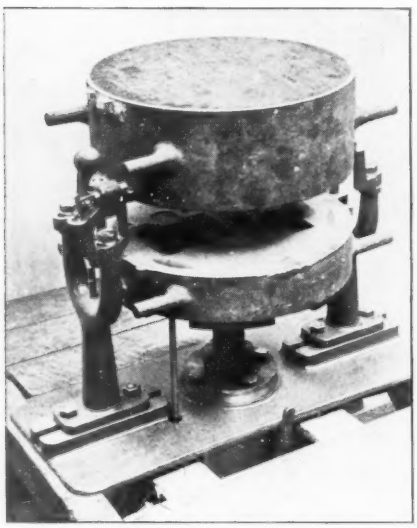


FIG. 11.

The general design of one style of this class of machine can be seen by consulting Fig. 8, and it will be noticed that it comprises a very strong base which is made as low as is consistent with the good working of the machine. The level of the table should not be more than two feet above the floor level so as to permit easy manipulation of flasks and sand. The base is left open on the sides for reasons that will be explained later. The table has a side projection bored to receive a strong pillar. In this pillar revolves a hollow steel column, at the top of which is fixed a cross beam and between the pillar and the cross beam there is inserted a ball bearing to reduce friction. The upper and lower ends of the hollow column are threaded and fitted with nuts to receive the thrust. The cross beam is bored centrally to receive the main ram and at the opposite end is fitted with a hook that can engage the side of the table as shown.

Projecting above the beam there is a return cylinder which is always under accumulator pressure and serves to automatically return the main ram when the exhaust is open. The main ram is threaded internally to receive the hollow socket which is threaded both internally and externally, and fitted with a hand wheel as shown. The eye of the socket receives a threaded projection upon the platen or face for receiving the ramming block. The main ram or platen is prevented from revolving by suitable devices so that when the hand wheel is turned the platen is moved up or

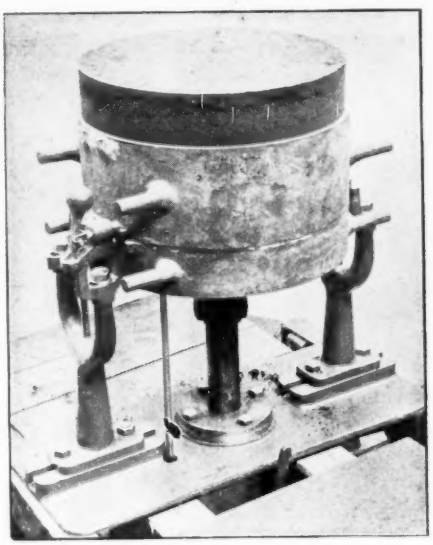


FIG. 12.

down. By this means the distance between the face of the table and the platen can be regulated according to the height of the pattern plates, flasks, etc., in use, thus saving time and also any unnecessary waste of water used under high pressure for compressing the sand.

When the machine is properly adjusted the stroke of the main ram is

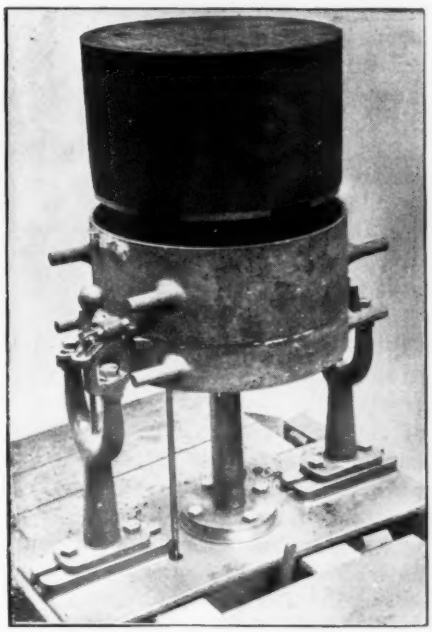


FIG. 13.

exactly the distance required to pack the sand. The motion of the main ram is controlled by a single lever which is very sensitive. Pulling the lever forward applies the pressure. Throwing it back to a vertical position closes the valves and maintains the pressure without change. Pushing the lever back opens the exhaust valve and permits the return cylinder to act, thus raising the ram clear of the flask. The lever can be stopped in the exhaust position and held by a spring rod so that the man has simply to push it back when his hands are free for other operations. The pressure is under constant control as it can be regulated by the valve to give any desired pressure on the gauge which indicates at any time the pressure in the cylinder. This advantage is quickly and greatly appreciated by the men and especially by the foremen and masters, for it is a cheap, quick method of insuring the production of good castings. One objection frequently expressed to the power ramming machine, is that there is a large percentage of bad castings turned out, due to blow holes or scabs. These defects arise mainly on account of irregularities in the hardness of the sand, that is, in the packing. For instance, in green sand work the drag may be rammed very hard, and it is best to ram it as hard as is consistent with good work, but the cope has to be softer and in some places where there are projections on the pattern it must be left very soft. With the Universal machine the pressure can be regulated and nothing is easier than to produce in a flask a mold having certain parts hard and certain parts soft. Also, when the proper pressure for a

FIG. 14.

certain class of work has once been ascertained there is no difficulty in reproducing the same conditions.

Water is brought to the valve through a stuffing box placed on the top of the hollow column, so that it is always easily accessible. The valve box in itself is very simple and of an entirely new design, so that in case a

valve is to be changed the transfer can be made in a few seconds.

The platen or ramming plate is drilled with four holes for fixing ramming plates of various sizes or forms to conform to the internal shape and size of the flask. In the illustration a round plate is shown and it will be

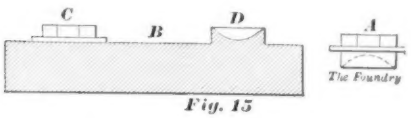


Fig. 15

noticed that the table of the machine is also round, although in the past it has been the custom to use square or rectangular flasks. The reason for this change to round flasks will be explained later.

One important point noted is that all wooden packing has been avoided, and that the face of the ramming plate is perfectly parallel to the table. The result is that with little attention if exactly the same amount of sand is used the ramming action will bring the plate just level with the flask, so that no scraping or striking off is necessary.

As explained before, the beam is arranged to revolve around a pillar, the hook being simply disengaged and pushed out of the way, as shown

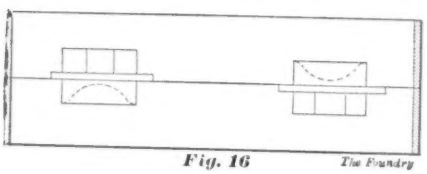


Fig. 16

in Fig. 9. When the beam is rotated back away from the table it leaves the latter thoroughly accessible on three sides, thus rendering all lifting which necessitates two men very easy, one man being on each side of the machine.

The center table is arranged with an opening as large as is consistent with the strength of the table, and the latter is partially filled by detachable bars put where necessary for supporting the pattern plates. It has already been stated that many vertical cores can be made with this machine and that patching is avoided by the use of stools for pushing these cores and the stripping plate where it is necessary to use them for supporting the sand.

The stripping plates are generally made of white metal by an improved process, and it is necessary to support them at different points on account of the fact that they are cut out to the form of the pattern and hence are not strong enough to be supported by the corners only. This is why the large central opening is left in the table of the machine. Supporting rods are placed wherever they are necessary to support the stripping plate and stools, so that when the flask is lifted all of the rods are lifted at the same time, thus rendering the breaking of the sand impossible.

A particular refinement in the use of stools has been devised and named "double ramming motion." This is not very clearly shown in the illustration of the machine, but it consists in arranging some of the stools so that when the pressure is brought to bear upon the upper face of the mold an additional pressure can be placed upon the parts by advancing the stools by means of a lifting ram, the amount of this advance being limited by suitable stops or collars. By the use of this device it has been found possible to mold a locomotive slide valve with 106 babbitting holes in green sand, the cores being green sand cores formed during the molding operation.

It can readily be seen that the rods lifting the flask are adjustable, both vertically and laterally, so that the machine can be made to take a very great range of flasks and different heights of pattern plates.

This pattern of machine is made in several sizes, according to the dimensions of the flasks required. The so-called standard pattern has a table about 25½ inches in diameter and can take flasks 24 to 25 inches wide, of any reasonable length, the only limit being the available pressure. A single plate placed upon the top of the table is all that is necessary when

using other flasks. The other patterns of machines are smaller and have tables respectively 22 inches and 17¾ inches in diameter. It has been found useful also to design a still smaller machine, worked entirely by hand. In this latter the ramming is accomplished by means of a screw and a fly-wheel and the lifting is accomplished by a lever worked by the foot. The small hand-power machine has been

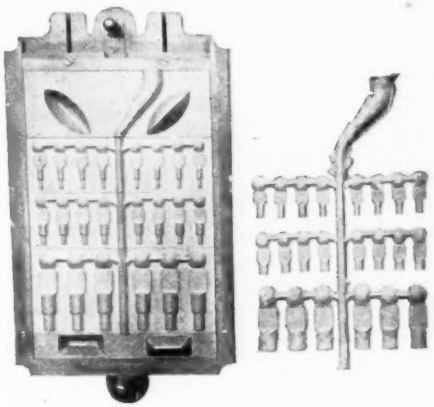


FIG. 17.

found very useful in foundries producing small castings. They are usually worked by boys and as they require no power can be set anywhere in a short time and used either in small or large foundries.

Another type of machine is manufactured which is much larger, using flasks up to 36 x 60 inches. This type is particularly well fitted for use in making molds for aluminum castings for motor cars, and also for any intricate iron castings for machines, condensers, pumps, etc., but the present article will be confined to the smaller type of machines which illustrate the principle of molding.

Assembling Machine.

Perhaps it will look strange to practical men to see a molding machine with a round table when it is the custom to use square or rectangular flasks. The reason for this is that most of the work is produced in green sand and is poured without flasks, even when making heavy castings. For this class of work the round flask has been found more convenient than the rectangular. A special machine called an assembling machine is shown in Figs. 10, 11, 12, 13 and 14. The work of this machine is not only that of assembling molds, but also that of pushing the molds out of the flasks. One assembling machine is generally worked in conjunction with two molding machines and by the use of this device only two sets of flasks are required for each molding machine.

One particular advantage of the assembling machine is that it permits the making of very deep molds by machinery. It can be seen from the illustrations that very heavy castings are obtained by this method and that it saves flasks, time in getting the castings from the sand, and labor in returning the flasks to the machines.

The assembling machine consists of a table or bed plate with a central hole, and two lateral slides. At the center is fitted a long cylinder containing a piston. The lateral slides receive two brackets. At the center

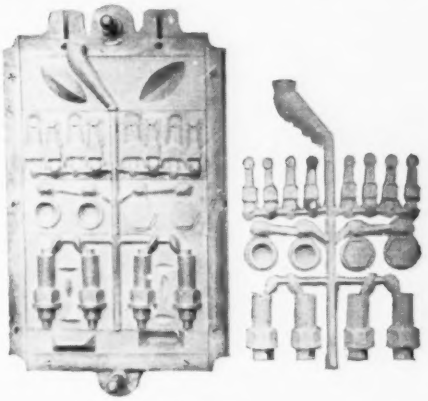


FIG. 18.

of each bracket is fixed a guide pin and on each side there is a projection arranged at a different distance from the guide pin, the right hand projection as seen from the center of the machine being nearer to the guide pin than the left. The flasks have similar projections, arranged so that when they are put on the machine with the parting line up they do not interfere with the projection of the

machine, but when they are turned over the projection of the flask and the machine would meet. Two locking bolts are provided for locking the upper flask onto the machine. At the center of the arms near the guide pins can be seen two rods which are lifted by counterweights. These

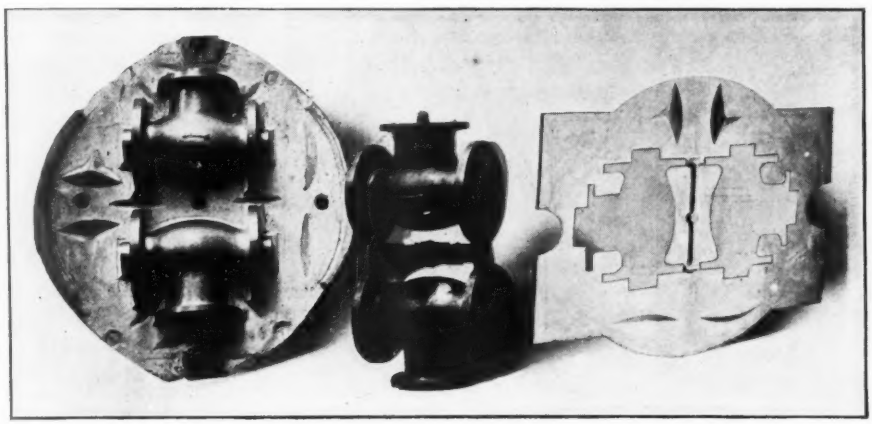


FIG. 19.

weights are sufficient to support the empty flask but not a full one. The working of the machine is well illustrated by the cuts and it will be found more satisfactory than to use snap flasks. Fig. 10 shows the machine with the lower flask in place. The

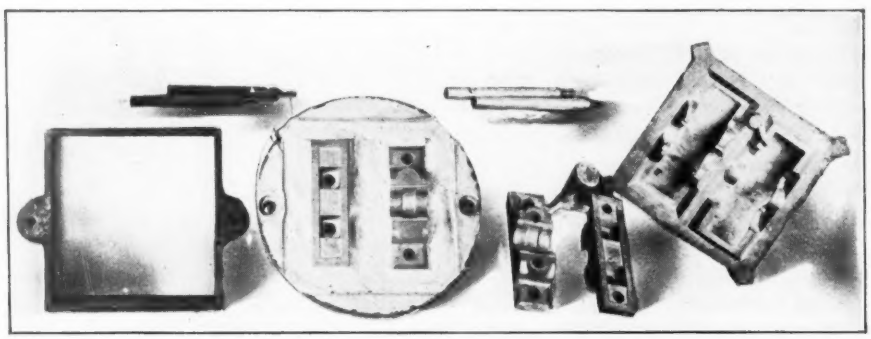


FIG. 20.

flask is perfectly level, being supported by the platen fixed on the end of the ram, and it is at the same time accurately guided by the guide pins. Fig. 11 shows the arrangement after the upper flask has been brought and placed in position with the parting line at the lower side. The upper flask is suspended above the lower by the projections upon the machine and flask coming together and is locked in position by the locking pins already referred to. Pressure is next applied to the ram beneath the machine and the two flasks or two portions of the mold assembled as shown in Fig. 12, in which the sand is seen as it is being pressed out of the mold. The arrangement of the parts after the mold has been lifted clear of the flasks is shown in Fig. 13. It is only necessary after this to lift off the mold and place it upon the floor ready for pouring. The machine, after the upper flask has been unlocked and removed, is shown in Fig. 14. The lower flask remains supported upon the

rods in such a way that it can be lifted off and taken away with ease. It will be noticed that the weighted rods referred to hold the flask at the top of the guide pins. This machine is very simple, effective and accurate and will be found useful in the saving of both time and labor. Of course, there are different types or patterns of assembling machines corresponding to the different patterns of molding machines.

Making Pattern Plates.

This is, without doubt, the most important part of the entire operation. Unless there are thousands of castings to be made the cost of pattern plates produced by the usual process is prohibitive, and even when the number of castings required is sufficient to warrant the expenditure, the length of time necessary to complete them is such that if castings are required quickly, it will be necessary to make part of an order by hand while waiting for the completion of the pattern plate. The Universal system has been devised to overcome these objections and includes all of the cases which arise in foundry practice. It is impossible to give a complete description of all the many applications of the process in an article of this kind, as it would fill a book in itself, but the illustrations given will show how some problems have been solved and we believe will be of interest to all practical men. It is first necessary to explain that what is known as the reversible system is used. Under the old system it is necessary to make two pattern plates to complete a casting, either by using two machines or by using a roll-over machine. The double-sided pattern plate used on the roll-over machine can be considered as two pattern plates.

To illustrate the method under consideration we will suppose that the pattern shown at A, Fig. 15, is to be produced and that the pattern plate is shown at the left of the figure. It will be noticed that one-half of the pattern, that is, the portion below the parting line, is located at D, while the portion above the parting line is located at C, these two parts being placed symmetrically with regard to the central axis of the plate, which passes along a line below B. The use of this plate will produce impressions, the center lines of which are equal distances from the center line of the plate B. If we then ram up two flasks exactly alike on the pattern plate, they will take on the right the

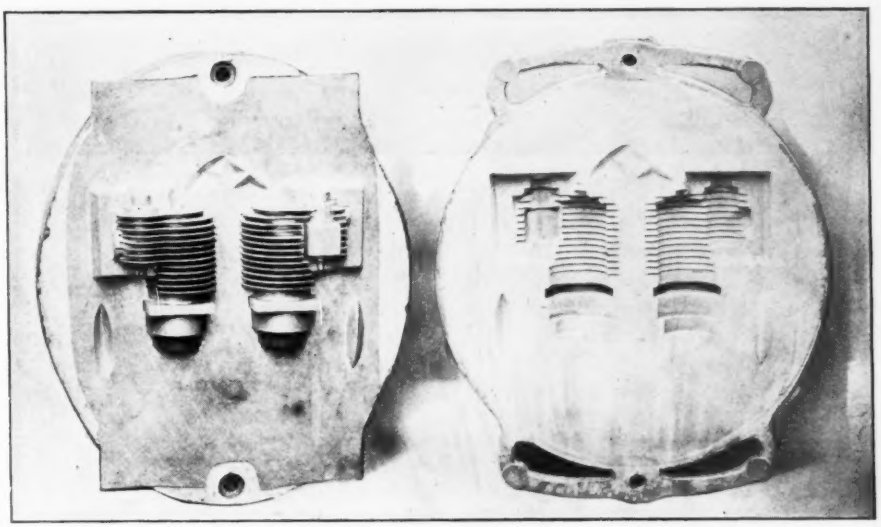


FIG. 21.

impression D and on the left the impression C, and if we put the two flasks one above the other with a central line corresponding, but with the upper flask turned over, so as to bring the corresponding parts of the impressions together, as shown in Fig. 16, we will then be prepared to produce two castings like that shown at A, Fig. 15, one of which will be right side up and the other wrong side up.

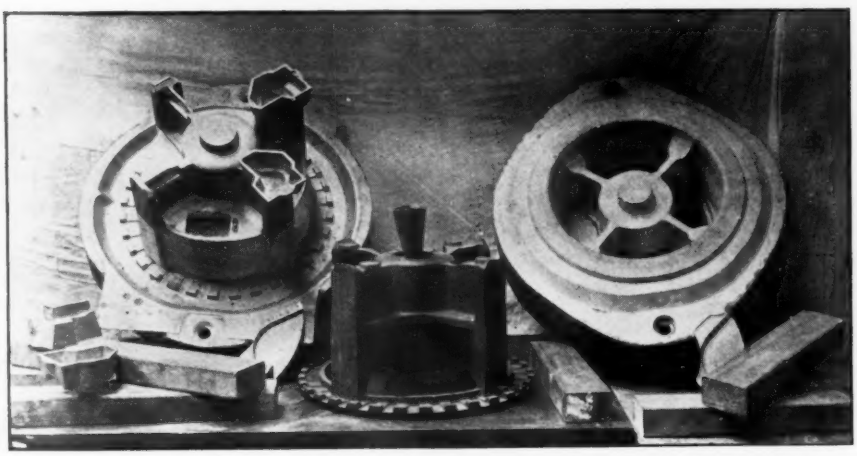


FIG. 22.

No doubt this machine possesses special advantages, for it requires but one machine, one man and one pattern plate. The question is to find some means of accurately locating the patterns upon the pattern plate and of doing this quickly. To accomplish this work it has been necessary to design a complete line of apparatus so arranged that, starting with the ordinary wooden pattern furnished by the customer, it is possible to produce a pattern plate therefrom in the foundry. This reversible process can be used in many ways for cutting down the work required in the production of duplicate castings.

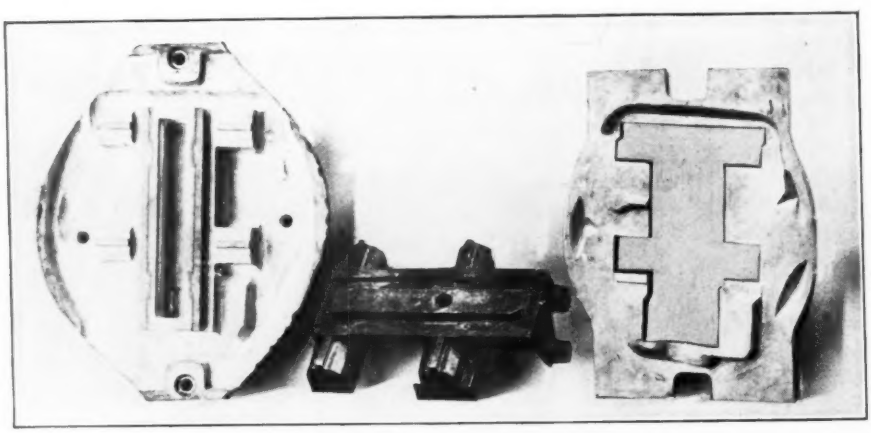


FIG. 23.

One application of this process is named "The Cliche" process. By this, several reversible pattern plates, the cliches or sections, are inserted in a frame, or table, of given dimensions, so as to use the same size flask in

each case. The sprues and the gates are on the sections so that the man does not have to cut the gates in the sand. Examples of this class of work are shown in Figs. 17 and 18. To change one section for another requires only the removal of six screws.

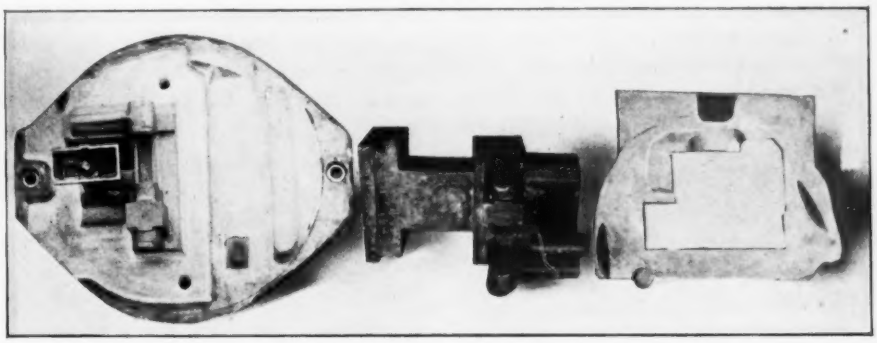


FIG. 24.

the placing of the new section in the place of the one taken out and the tightening of the screws once more. The sections are made of non-shrinking white metal and are produced by a process so designed that from the pattern furnished by the customer the complete section can be put on the machine in from 30 minutes to two hours, depending upon the conditions.

The advantages of this process are many. First, the cost of the sections is very small, as it is much less than it would cost to produce duplicate patterns. In many cases it has been found profitable to make a section for the production of twenty castings which would never have to be reproduced again. In this case the section is simply melted down when the order is completed. The use of these special pattern plates with the sections introduced, permits the use of the machine for a long time without changing the style or size of flask when a new pattern has to be introduced. A small hurry-up order can be inserted in a very large order without losing a minute. The sections being even and of standard dimensions can be filed in racks very easily and can be found when required more readily than small patterns could in an ordinary storage system. The use of this system extends the range of the molding machine for small castings so that many times the number of pieces can be produced and the system can be made available for work which would otherwise not be put on the machine.

This reversible system can also be applied to larger castings. Two examples of larger castings have already been shown in Figs. 2 and 5. The pattern plate, stripping plate and castings produced therefrom for a pair of

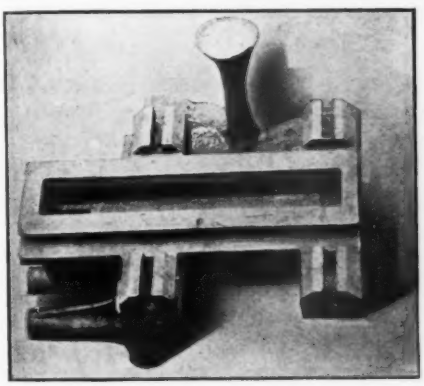


FIG. 25.

valve bodies are shown in Fig. 19, illustrating the use of this system for fairly heavy work. The pattern plates, stripping plates and stools necessary for producing a small box are shown in Fig. 20, and in Fig. 21 are illustrated a pattern plate, patterns and castings

for producing an air-cooled motor cylinder. From these examples it can be seen that the reversible system is not limited to small castings, but can be applied to a large number of orders which are made with it in everyday practice. When the castings are too large for the placing of at least two in a flask of reasonable size or when it is necessary to have the castings turned out with a certain side up, or when on account of the shape of the castings it is not possible to arrange them side by side it will be necessary to resort to the double pattern plate.

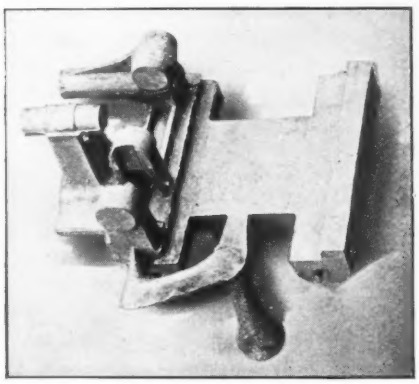


FIG. 26.

There is one point that must be especially emphasized and that is the use of the stripping plate with either reversible or double pattern plates. These stripping plates are made by a patent process, so that they, like the pattern plates, are produced entirely in the foundry without any special fittings. The time required for producing the stripping plate varies from one hour to two days, according to the size and the difficulty of carrying out the work. From the illustrations shown it will be seen that these stripping plates are not limited to simple forms. The parting line can be of any desired form and the stripping plate follow it. Sometimes the stripping plate includes a portion of the pattern, while in others the stripping plate is internal and supported by the stool. Sometimes one pattern plate includes several stripping plates, as in the case of the spider illustrated in Fig. 22.

A very interesting double pattern plate is shown in Figs. 23 and 24, and the castings produced therefrom in Figs. 25 and 26. Another difficult casting which is produced by this process is the aluminum body for supporting a 4-cylinder engine in a motor car.

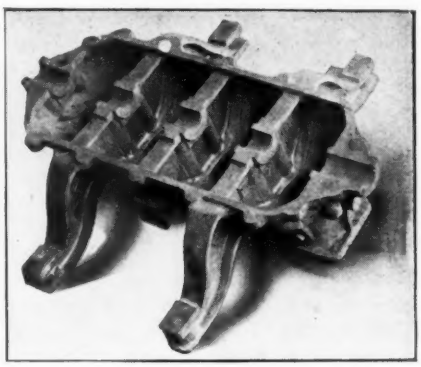


FIG. 27.

This is illustrated in Fig. 27. It would be a very difficult matter to give a full description of this new process in so short an article, but it is easy to see that the machines can be used for a large variety of work and for shallow or deep pieces. Molding machines of this type are being rapidly introduced into England, Russia, France, Switzerland, Spain and other European countries.

It is also interesting to note that several foundries in Mexico have adopted the system, as the makers have an agency in that country. A paper describing this process was read before the British Iron and Steel Institute at its recent meeting and brought forth considerable discussion. The makers are also planning for an extensive exhibit of these machines at the American Foundrymen's Association convention to be held in Philadelphia, May 20 to 24, 1907.

THE REDUCTION OF FOUNDRY COSTS.

By H. Cole Estep, Engineering Department Northern Pacific Ry.

Cost reduction in the foundry, while of prime and fundamental importance, has only recently begun to receive the study and attention it merits. This reduction is of value in two ways: It enables the manufacturer, without reducing the quality of his product or scaling down his profits, to meet competition with a lower selling price; or, without affecting the market price, it may allow the introduction of a more expensive finishing process, resulting in an appreciable betterment in the quality of the product. Either way it is of permanent value since it benefits both the manufacturer and the consumer.

The general problem of cost reduction divides itself naturally into two parts: First, an analysis or differentiation of the whole cost into its constituent elements, and second, a redistribution, alteration and reduction of these cost-elements so that the new integrated total cost will be less than before. In making the cost analysis we should bear in mind that to be of any value it should show the following:

(1) The ratio which each cost element bears to the total cost of production, called the cost ratio.

(2) The relation which the various elements bear to one another.

(3) The aim being to reduce the whole cost we should first consider the direct effect which a change in any one element will have over other elements and thereby over the whole cost. For instance, while cheap coke might be had in Minneapolis for three dollars a ton, the direct effect of the much poorer grade of castings produced by this coke would more than balance the saving effected in the lower price of fuel.

The total cost of making a casting may be divided into three parts: Fixed charges, management expense, and production expense. These will be taken up in the order named.

The element of fixed charges is the most definite, easily ascertained and controlled item in the cost analysis. While it may amount to as much as ten per cent of the total cost, it is usually less than any of the other items. Whether or not the foundry operates, the fixed charges do not alter and in order that they may be kept at an irreducible minimum it is necessary that the foundry run continually at its full capacity. The importance of this factor is seen in the adoption of a normal working day, varying from twenty to twenty-four hours of two or more shifts, by many large eastern foundries.

The detailed consideration of the fixed charge cost element can be best studied by separating it into its natural divisions, insurance and taxes, depreciation and interest.

In many large foundries where firebrick, non-combustible roofs and doors, metal flasks and patterns have reduced the fire risk to an almost negligible quantity, either no insurance is carried or the rate is very low. Many foundries carry no insurance but consider themselves sufficiently protected by the employment of a night watchman, who is often hired to look after several establishments in the vicinity, and thus the individual expense is very low.

Property suitable for the location of foundries is usually valuable and consequently the taxes are often high. The modern tendency to establish industries, not in the center but in outlying industrial suburbs, is commendable and often very materially reduces the charges due to taxes.

On account of its great variation—ranging from one or two per cent on buildings to twenty-five per cent on small tools—and a frequently marked uncertainty of its real value, the factor of depreciation in foundry costs is often, unnecessarily, much larger than any of the other elements among those grouped as fixed charges. Depreciation is most rapid on patterns, crucibles, flasks, small tools, and machinery auxiliaries.

In order that the depreciation on patterns be as low as possible they should be properly stored, indexed, kept in a dry and even atmosphere, and should not be thrown on the shelves of the pattern room in a disorderly jumble as is often the case. In foundries where a large variety of patterns are used, economy has resulted from the adoption of a system of pattern checking, similar to the tool room system of many machine shops, whereby each molder receipts for the pattern he takes out by depositing a numbered check, which he claims when he returns the pattern to the store room. This results in the prompt return of every pattern to the store-room and in a marked decrease in losses and breakage. Where a large number of similar castings are to be made the most economical plan is to make but one wooden pattern and then from it to cast, out of composition metal, a number of metal patterns. These are much cheaper and more durable than the wooden ones.

Excepting small tools, flasks, especially wooden ones, suffer more from depreciation than any other foundry utensil. Cast iron flasks are justly becoming very popular, and except for large special pieces of peculiar shape and of which only one casting is required, are much more economical and far more durable than the wooden flask. Cast iron flasks of standard size should be kept in stock by foundries doing general work. Order and arrangement in the storage of flasks will materially reduce their depreciation.

The heaviest depreciation occurs undoubtedly on the stock of small, miscellaneous tools. The tools are lost, broken, mislaid and stolen, and usually a large proportion of this loss can be eliminated without incurring any other expense than would be involved in the wages of a tool room attendant. The molders should be required to furnish their own trowels, slicks and and other small tools that are in constant use. This plan will result both in economy to the management and in more satisfaction to the employes. For the care of all other small tools necessary in the foundry, a tool room operated on the same principle that modern machine shop tool rooms are conducted, should be established. It will soon pay for itself in the decreased depreciation on small tools.

The matter of reducing the interest on the capital invested is a problem in finance rather than in operation, and is beyond the scope of this article.

The element of management expense may be divided into two items; general office expense and selling expense. The exact value of this element is neither very definite nor easily determined; and it varies widely with individual conditions.

Because the office force is comparatively small and the expense apparently light, the possibilities for reducing costs in this department are often overlooked, with the result that the numerous small leaks which a careful study of the individual conditions involved would expose, remain undetected. For instance, worn-out systems or unnecessary red tape with consequent increase in clerical expense, or failure to exact a fair degree of efficiency from the office employes often materially increase the cost of making castings. Inefficiency in this department is less excusable than in the others, because, in general, a reduction of the cost involves no increase in any other item, and is all clear gain.

One of the most effective ways to reduce the cost is to increase the production—but unless this increased production can be sold at a profit it is worse than useless. Advertising, publicity, is one of the principal factors in the modern method of selling goods. Many foundries otherwise economical and efficient are most wasteful in their selling department. It has been amply demonstrated in every other line of industry that money and time spent in judicious advertising is well invested. If the product of the foundry can be quickly and profitably sold a great many wastes and unnecessary costs can be avoided. Yet, in a recent issue of one of the most promi-

nent technical journals in America, there was only one advertisement by a foundry company that would attract even casual attention. Foundry managers, if they wish to reduce their selling costs to an economical basis would do well to investigate the value of intelligent, well-written advertising, published in the right periodicals.

The third and most important of the list of major cost elements is that of production expenses. It may be subdivided as follows: General production expenses, cost of raw material, transportation costs within the foundry, and labor costs. Under general production expenses we may consider the cost of light and heat.

As one writer expresses it,* "a cold, poorly ventilated shop is killing in its benumbing influence on a man's ambition and dexterity." In fact the day has gone when it was considered economy to save coal bills and pay them double in the resulting decrease in the efficiency of the employes. Labor is the largest element on the cost sheet and any reasonable means which will increase its efficiency, enlarge the output, and thus reluce the cost, is economy. A blast of air heated over a few coils of exhaust steam is an economical method of heating and an effective way of increasing the efficiency of labor in cold weather.

If true economy in lighting expenses is desired, the foundry building should be so designed that, in the day time, artificial light would be very seldom necessary. This condition is by no means impossible; most new buildings fulfill it very well, and at only slight expense even old poorly lighted structures can be improved, for instance, by substituting ribbed for plain glass in the window sashes. Every day the windows should be washed down with a hose to remove the deposit of light obstructing dust, inseparable from molding room atmosphere. The interior ceiling and walls should be white-washed and kept clean. Often the observance of these two suggestions will cut the lighting bill in half. In short, efficient work cannot be done in the dark, and sunlight is vastly cheaper than electricity.

The problem of reducing the cost of raw material is principally a matter of financial shrewdness, of ability to take advantage of market conditions, and not a problem in operation, and therefore is beyond the scope of this article.

The frequent necessity of moving heavy ladles, cores, castings, fuel, and other material from one point in the foundry to another, involves a cost item of considerable importance. A foundry lacking in a systematic, efficient system of internal transportation is in a very poor position for economical production and effective competition. The importance to the transportation problem of good general design in the layout of the plant and in the arrangement of the various departments is supreme. Although the costly effects of a poorly arranged plant can in many cases be largely overcome by good internal transportation facilities, they can never be eliminated.

To procure the lowest transportation costs the foundry should be compact, not crowded, but so designed that every piece cast travels as short a distance as possible, without at any time retracing its path. To this end the molding floor, with the cupolas centrally located on one side, should be spanned by one or two traveling cranes; the heaviest castings should be made nearest the cupolas and loaded by cranes directly on to cars, for transportation to other establishments or buildings. Where a great number of similar light molds are to be set up, it is advisable to use a portable molding machine, moving the machine along the sand heap as the molds are made. Often, to save floor space, several flasks are piled together and fed from one runner. Another method of handling light molds is to have an endless moving platform. The molds are made at one end, set on the platform, carried past the cupolas, poured, further on shaken out, the sand and flasks removed, while the castings, which are sometimes cooled by passing under a spray of water, go on to the finishing room.

The chipping, cleaning and storing rooms should be arranged around the

*O. M. Becker in "The Square Deal in Works Management." Eng. M.

sides of the main floor, provided with suitable arrangements for handling heavy pieces, and so arranged that the casting passes through them successively. The tool room, sand storage, flask storage, pattern shop and store room should be similarly arranged around the main floor, if possible, and preferably on the same level, provided with a suitable telpherage or industrial railway system for the rapid and economical handling of materials. Where possible, the cars containing the coke and raw material should be brought to the charging floor level, and the storage facilities for these materials should be on this level. Where this is not possible some system of elevators is necessary to convey the coke and iron to the charging floor.

The expense of labor is the largest item on the foundryman's cost sheet, and is about one-half the total cost of making a casting. The problem of increasing the output without increasing the labor costs is being solved in the foundry just as it has been solved in every other industry,—by the introduction of automatic or quasi-automatic machinery. The extensive use of machinery in the foundry is quite recent. While nearly every other art was being revolutionized by modern machinery, the art of making molds for cast iron still clung to its old-time methods. Finally though, competition demanded that the old, laborious, uncertain process of mixing, ramming the sand and drawing the pattern by hand, and carefully and *slowly* patching the mold, be discarded; thus in spite of generations of prejudice machinery is finding its place in the foundry. The molding machine is foremost as a saver of labor costs. Every pattern of course cannot be handled by machine, but for comparatively simple pieces and for all pieces made in any quantity the molding machine will save its cost many times over in a year. For instance, in the molding of a 24-inch bevel gear, the cost per piece is eight cents by hand and one and eight-tenths cents ($.018) by machine. The machine costs $180 and will make 225 molds in a day of nine hours.

While all progressive foundrymen are now thoroughly posted on the cost reducing possibilities of machinery they are barely awakening to the fact that the human machinery of the plant needs much care and thought to keep it at its highest point of efficiency. Other things being equal the plant that survives competition, is the one whose employes by being well paid, cared for and treated "on the square," are loyal, enthusiastic, and efficient.

The wage system is the first important consideration in producing an efficient working force. Attractive and liberal scales will draw to the foundry the best and most expert workmen. While, owing to the nature of the work, much of the labor must be paid for at so much per day, yet in foundries where large quantities of light, duplicate pieces are cast, a premium system furnishes in addition to the regular daily wage, extra compensation for the man who can turn out more work than the average, is encouraging to the employes and satisfactory to the management.

In order to get the best workmanship attention must be paid to the surroundings. The shop should be light, warm, clean,—even a foundry can be clean—and cheerful. Plenty of white paint inside and a hose will do wonders in this direction. In regard to this matter of the effect of environment on the worker one authority says: "Inattention to this matter usually brings its own immediate punishment in the reduced activity of the workers and their consequently diminished output. Janitor service, of course, entails expense, but slovenly workmen entail a greater loss, and slovenly workmen and workmanship are legitimately begotten of slovenly surroundings."

In general, success in cost reducing comes only by patient attention to detail, close observation, accurate knowledge of conditions, and sufficient fearlessness to test new ideas, systems, and methods. If not carried to the extreme of parsimony it is a benefit to the foundryman, the foundry owner and the consumer.

The Foundry Chemist's Lament

(British Version.)

In years back a score, when I worked on the floor
And things sometimes went wrong with the cast;
If bad castings were made, we never got paid,
But were walked 'round to see our scrap smashed.

But since those dark days, they have found better ways,
And when wasters are cleaned off from sand,
The blame is laid now on the chemist, I vow,
Because he's left out the old man's favorite brand.

If it's holes that are small, perhaps containing a ball,
Or as big as your head from a large blown gas bubble,
The foreman knows how and will swear to it now,
That it's nothing but shrinkage that causes the trouble.

Now, the up-to-date molder, whether younger or older,
Who is sure a bad casting he never has made,
Puts little reliance in the fragments of science
Possessed by that chump in the chemical trade.

At his mixtures they sneer, the components so queer,
A conglomeration which takes no small fixing;
He must be quite crazed to mix mottled with glazed
And expect sound castings to be made from the mixing.

It seems very strange when the irons he will change—
Those with great reputation he leaves out, it is said—
As they charge for the brand which is stamped in the sand
Before the pig iron is run into the bed.

All his ideas are wrong, they are not worth a song,
When large castings are wasters and small work is bad;
For they say the scabbed metal, which the chippers can't fettle,
Is caused by the chap who is running the lab.

His talk about carbon is nothing but jargon;
His notion of phosphorus is much of the same;
His silicons all rot, and they don't care a jot
For manganese and sulphur will finish his game.

He can spoil any brand that is made in the land
By putting some steel scrap into the mix;
Though the test bars are strong, something's sure to go wrong
Which will put the old man in a terrible fix.

There is sure to be strife if the iron has no "life"
And cannot be held long enough fluid in the ladle;
He has left out the scotch and made a hotch potch
As thick as a pudding ever seen on a table.

Now, the poor analyzer, sneeringly called paralyzer,
Who's expected to turn all bad irons into good,
Has a hot time, you bet, and may get even yet,
But it won't do to holler 'till he's out of the wood.

He even expects, but it gets small respects,
All the coke and the iron in the charge to be weighed;
He wants the pig stacked, why, his brain must be cracked,
For it's always gone straight from the truck to the stage.

It is said there's a dearth of scientific research;
There's no doubt that the foundry's in need of a lot,
But researching don't pay in the foundry way,
You must work or you will find yourself out of a shop.

Now, although I'm no poet, I should like you to know it,
The truth should be put into a nutshell;
I'm quite cured of ambition to fill the position,
As a foundry chemist now I've thrown off the spell.

So, young chemists beware, the foundry's a snare
To catch the unwary who think they know all;
It's a place where they muddle, where the chemist meets trouble,
So stay out, or you'll wish that you'd never been born.

CHEMICUSS ANALYTICUSS.

BRASS FOUNDING

THIS DEPARTMENT IS DEVOTED TO THE TREATMENT OF ALL ALLOYS INCLUDING THEIR

FOUNDING, GRINDING, POLISHING, ELECTROPLATING ETC.

BRASS FOUNDRY DEPARTMENT OF THE WESTINGHOUSE ELECTRIC & MFG. CO., EAST PITTSBURG, PA.

It is difficult to state off hand what is the most interesting point about the brass foundry department of the Westinghouse Electric & Mfg. Co. traveling crane manufactured by the Whiting Foundry & Equipment Co. This crane has a span of 22 feet 4 inches, and travels the entire length of the central bay. In addition there is a trolley track system in each of the side bays and also extending a portion of the length of the central bay. There are also several post jib cranes for serving different parts of

CENTRAL BAY OF FOUNDRY.

One of the points which strikes the visitor most forcibly is that the foundry proper is located on the top floor, which is in this case the third floor. The foundry proper is 75 feet wide by 414 feet long and is divided into three bays. The central bay is 24 feet in width and is provided with a five-ton the floor. The heavy floor molding is all done in the central bay and castings weighing as much as 7,000 pounds have been made in this department.

At the end of the bay nearest the furnace a portion of the floor has been depressed to form a pit for large molds. The foundry is provided with

a concrete floor, the frame work being of structural steel and exposed, but there is very little inflammable material in the department and hence a fire is not likely to occur. Ample protection against fire is provided in the form of sprinklers, fire hose, etc.

Very little of the sand is cut over by hand, practically all of it being tempered by machinery. In fact, the sand used in the molding machine bay is all tempered by machinery. This bay is very clearly shown in one of the illustrations. The sand is conveyed the length of the bay by a reciprocating conveyor. It is supplied to the molding machines by swinging spouts.

MOLDING MACHINE BAY.

The molding machine operators have only to make the molds and place them on the floor, the pouring being done by a separate gang.

After the molds have been poured they are shaken out over a metal grating in the center of the floor. The castings remain on the grating, while the sand passes through to a conveyor that returns it to the tempering apparatus which is located on the mezzanine floor below the regular molding floor. This apparatus consists mainly of a riddle and an inclined belt conveyor which carries sand up and into the boot of the regular elevator which delivers it to the reciprocating conveyor overhead in the foundry. The small amount of new sand which has to be put into the mixture each day to make up for that which adheres to the castings and is cleaned off in the cleaning department is simply shoveled into the riddle over the inclined conveyor a little at a time during some period in the day and in this way it becomes thoroughly blended with the old sand. For the molding machine work but one grade of sand is used.

The melting equipment consists of 12 crucible furnaces, the largest of which contains a No. 100 crucible, and seven 42-inch and two 60-inch Schwartz furnaces. The most of the metal is melted in the Schwartz furnaces, and the metallurgical depart-

ment reports that the melting losses are very small and this style of furnace has been found to give thorough satisfaction.

The total output of the foundry is between 13,000 and 14,000 pounds of metal per day and is divided over quite a wide range of alloys. The standard alloys used are known by arbitrary numbers, and the designers know the physical, electrical and magnetic properties of each of the alloys and specify them accordingly. The alloys vary all the way from practically pure copper through brass, bronze and white metals to the ordinary bearing metals and aluminum.

The work of the metallurgical department is under the supervision of the chemical laboratory, which is thoroughly equipped for both chemical and physical tests. Tests are made each day of the different alloys to make sure that they are being kept up to standard.

The molding machine equipment is made up of 19 Tabor and 15 Pridmore machines. Some of the machines are located in one of the side bays where they are not convenient to the sand conveyor and hence the sand is cut over by hand.

All of the metal for pouring is handled in the large ladles supported from suitable lifting levers hung from the trolley hoists or from the traveling crane. In this way it is possible to convey hot metal to the farthest part of the foundry very quickly. The ladles are heated by jets of crude oil and the Schwartz furnaces are also heated by the same means.

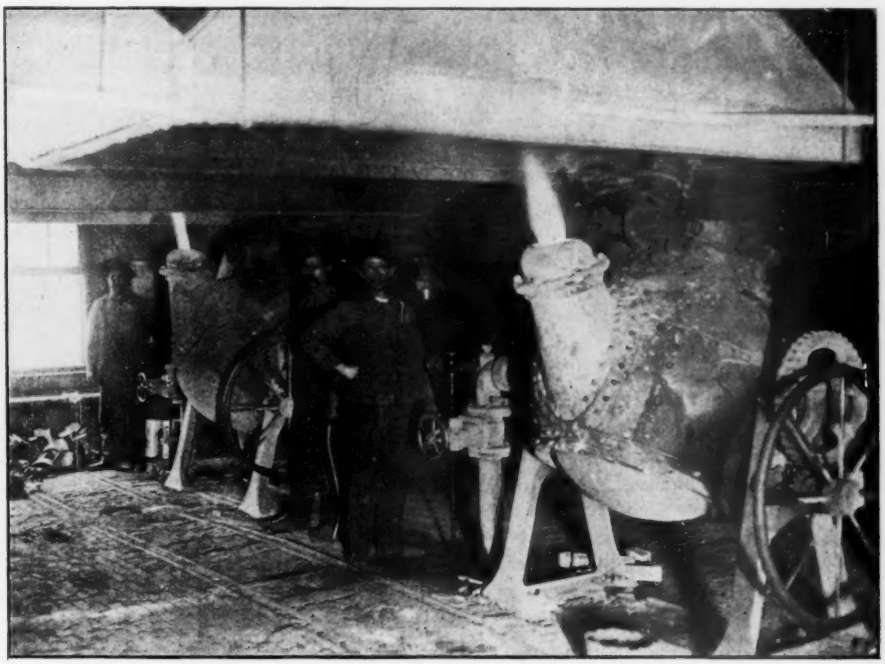
SAND TEMPERING MACHINERY.

The cleaning department is located in a room adjoining the foundry and is equipped with metal band saws, sprue cutters, grinding stands and all of the appliances necessary for such a department. The grinding stands are provided with an exhaust dust collector system and the metal which accumulates in the dust chamber is recovered.

The mezzanine floor, which is situated below the regular foundry floor, is utilized as a pattern storage and contains 11,800 square feet. The room

is 10 feet six inches in height and is provided with pattern racks suitably designed for containing the different classes of patterns, match plates, etc.

On the mezzanine floor is also situated a pair of cinder crushers which take care of the slag from the furnaces, the metal contained in the slag being recovered and used in mixtures for which it is suitable.



TWO OF THE SCHWARTZ MELTING FURNACES.

The placing of the foundry on the top floor in the manner described insures the best of light and ventilation, which are very important indeed in operations of this kind.

The long conveyors used for moving the sand overhead or under the floor are of the reciprocating type and considerable experimental work has been necessary to determine which is the best speed at which to operate these conveyors so as to prevent the sand from balling up and becoming unfit for use. It has been found, however, that different grades of sand will ball under different conditions and that the proper speed for one grade might not suit all grades.

BRASS FOUNDRY NOTES

BY C. VICKERS

TROLLEY WHEELS.

Everybody in these days of electric street and interurban cars, knows what a trolley wheel is, so an extended description of such a well known article will be unnecessary.

Trolley wheels are made either of copper or bronze, as the most important requirement of a trolley wheel is conductivity, a wheel that is a poor conductor, will go spitting and flashing along its way damaging not only itself, but what is of far greater importance, the overhead wire.

This "arcing" of a trolley wheel raises little hills or projections in its groove which are exceedingly hard and abrade the wire.

It is unnecessary for a trolley wheel to be made of copper having a high electric efficiency, as is the case with commutator brass. Bronze will answer the requirements in regard to conducting just as well as copper, as there is always sufficient metal in the wheel, to carry the current. What is desired is a metal that will not arc, will wear reasonably

well, and be as easy as possible on the wire.

As before stated, the preservation of the wire is a first consideration. It is easy to replace a trolley wheel, but expensive to put up new wires. Therefore some traction companies have for this reason discarded the use of a hard bronze wheel and substituted one of copper, the idea being that as the cast copper is softer than the hard-drawn trolley wire, the wire cuts the wheel instead of the wheel wearing out the wire.

Copper trolley wheels, however, are not always as soft as their coppery appearance would suggest. A certain degree of hardness is, of course, necessary, but some foundries making a specialty of copper trolley wheels, harden them to such a degree that they are much harder than the wire, thereby defeating the purpose for which copper was used, as such wheels must be as hard on the wire as the bronze ones.

In the writer's opinion, a good soft gun metal is hard to beat for this class of work, a very suitable alloy being sixteen pounds of copper to one of tin, adding to every one hundred pounds, three pounds of zinc, no lead being used in trolley wheels, as it favors arcing.

Phosphorus is used to harden copper wheels, and by its use they can be made exceedingly hard.

A medium hard alloy contains one half pound stick phosphorus to one hundred of copper.

Another good copper alloy is 97 pounds copper, 2 pounds tin, 1 pound silicon copper.

The diameter of the ordinary standard trolley wheel is five inches and wheels of six and seven inches diameter are also used. The greater the diameter of the wheel the better service it gives, as it does not revolve so rapidly. The size of a wheel, however, is limited by its weight, a seven inch wheel being almost too heavy for the trolley base, the springs being unable to keep the wheel up to the wire. The question naturally suggests itself, why not increase the power of the base springs? There is a limitation to this, however, and that limitation is almost reached in holding up the average six inch trolley wheel.

With a view to overcoming this difficulty enabling the use of a larger wheel, the writer a short time ago, made a six inch wheel of aluminum and phosphorus and caused it to be tried out on an interurban car.

This wheel lasted just five hours making a trip of about 85 miles, and when taken off one side was entirely cut away, and the other partially.

The wheel was a total wreck and a complete failure, showing that large wheels cannot be obtained by substituting light aluminum alloys.

The average life of the ordinary phosphorus trolley wheels is five thousand miles.

PAPER MILL ROLLS.

I would like to know if you can give me any information in regard to making brass shells for paper mill rolls. I am making them and am having a little trouble in making some of them, that is, they come porous. That is, the holes are clean holes, some are large and some are small. I think they are holes caused by gas or the temperature of the metal. I have melted the metal in a cupola and also in an oil furnace and have the same results. They sometimes come dirty, which I think is caused by blacking coming off. I run them from the top with pop gates. They vary in size from 10 inches in diameter to 20 inches in diameter and 144 inches long. The metal is about ¾ inches to ⅞ inches thick. The mixture I used is 65 per cent pig, copper and brass, 30 per cent zinc and 5 per cent tin.

My mold is thoroughly vented. The outside looks nice in the rough, but when they are turned up they have the clean holes That is, these holes show no dirt in them, and some are dirt holes, which shows that they come from the core scabbing a little. My core is made in loam, that is, it is made on a pipe, according to the size of the core wanted. The pipe is full of ½ inch vent holes and wrapped with hay rope and the mixture of sand for

the core is 2 parts of coarse molding sand No. 3, 1 part of No. 1 fine molding sand and 1 part of fire sand Jersey and 1 to 40 of flour.

My mold mixture is three parts of No. 3 coarse molding sand and two parts of No. 1 fine molding sand and two parts of old sand and 1 to 40 of flour. My blacking mixture is 1 pint of molasses and 3 gallons of best plumbago, and I have tried 1½ parts of charcoal and 1½ parts of mineral and 3 parts of plumbago. Let me know what you think of this. Some think I do not pour the metal hot enough. I think I might have better results by pouring them dull, as I can get the metal and run them. I have got some of them, but not as perfect as I would like to have them. They have to be perfectly clean.

The shells that I make are cast on end with pop gates. About four gates 1¼ inches wide by ½ inches thick on a 12½ inch shell with two vents taken off of the top of the mold.

I have also used a mixture of 15 per cent pig copper, 5 per cent wire cloth, 30 per cent good chips and 50 per cent brass scrap.

Answer.—The trouble in this case is sponginess or porosity. At some time or other the metal has absorbed gases, these have entered the mold with the metal and have held their own against its pressure, forcing it away here and there, so that when the surface of the casting is broken in machining holes are found, clean holes; holes made by gas, not cored out by chunks of sand, or dirt as the molder calls it.

When holes are caused by sand, blacking, charcoal, etc., the "dirt" is always found in them. Such things never do their work and vanish but stay right there and face the music, and we can generally see some indications of their presence on the skin of the casting.

Every molder knows how to deal with such things, and he sees to it that they do not recur very often. But in the case of holes under the skin of a casting, holes that are full of emptiness, are nice and slick and clean, no matter what their size whether "pin" holes or bigger holes, they own one origin, and that is gas, the gas is usually oxygen, the metal has been oxidized, somehow, somewhere, and at some time. This oxide has been dissolved by the molten metal (for copper possesses the property of dissolving its own oxide) and when it solidifies, some of this gas is occluded. The surface of the molds chills the metal immediately in contact with it, so that the gas cannot pass out, but remains and forms holes.

Exceedingly few brass or bronze castings are free from oxide, but unless it is present in excess, it does not cause honeycombing. but merely weakens the alloy, therefore in melting copper and its alloys the metal should be protected as much as possible from atmospheric action.

I am not at all favorably impressed with the alloys mentioned, the first one I think entirely unsuited to this class of work.

The correspondent uses 65 per cent pig copper and brass now how much "brass" is there in this 65 per cent, and what kind of brass is it?

There ought not to be any brass at all in this mixture, the 65 per cent should be all copper and when we add 30 per cent zinc, we have just a common yellow brass, in this case rather high in tin, consequently hard, a very difficult metal to cast, clean, into heavy castings.

The second alloy containing 15 per cent copper, 5 per cent wire cloth, 30 per cent chips and 50 per cent brass scrap is a much better alloy for such castings but it should be first run into ingots to make it homogeneous.

Chips ought always to be run down, as if used direct, they are very liable to cause porosity because of the enormous surface they present for oxidation.

A second melting always removes much of the oxide, for this reason, scrap metals are improved by being run into ingots. All scrap metal is

dirty and covered with oxide, which the first melting dissolves. Therefore direct poured castings, run the danger of being "dirty" or porous or both. Crucibles, fuel, and labor being expensive it is only natural, that the running of such materials into ingots, is avoided as much as possible. and, in the case of small castings, scrap may be, and is, used with little risk, by carefully melting, well stirring, and skimming, and pouring the metal hot.

But for such castings as we are now considering, the direct use of such metal is a poor economy, as the failure of one casting may cost more than the reduction into ingots of sufficient material to make a half dozen castings.

A spongy casting does not reveal its defects, until it is placed in the lathe and a cut taken off. Then all this labor is wasted, as well as the labor of making the casting, and the casting must be cut or broken up, before the metal can again be utilized.

Therefore if such material (scrap and chips) must be used in such work, first run it into ingots, using some good deoxidizer such as phosphorus, or silicon.

Phosphorus may be used in the shape of phosphor-copper, ½ pound to the hundred pounds of metal, or phosphor-tin, one pound to the hundred. It may also be used in the stick form which is preferred by some. Two ounces of stick phosphorus will be sufficient for 100 pounds of metal.

In using stick phosphorus, take a small cup, half fill with water, and balance on the scale, then set scales to weigh the quantity of phosphorus desired. The phosphorus should be broken into small pieces; to do this remove a stick from its water bath, and holding it lightly in the palm of the hand, give it a smart rap with a tack hammer or handy piece of metal.

The hand should be wet, never grasp the phosphorus, as it takes fire spontaneously when out of water, and the heat of the hand is sufficient to inflame it, therefore handle it quickly and with care, and always keep it covered with water, when there is no danger.

The phosphorus being in small pieces (say 2 inches long), it may be placed into the balanced cup, until the scales again balance. The cup may then be carried to the furnace, the cover of which is removed sufficiently to permit the phosphorus to be tossed, a piece at a time, onto the charcoal covered surface of the melted metal, each piece should be pushed down, and allowed to vanish, before another one is added. The phosphorus may be handled with a small pair of spring tongs, similar to sugar tongs, which can be readily fashioned from a piece of strip brass.

When the phosphorus has been put in, the metal may be heated for five or ten minutes, then removed and run into ingots. After such treatment the danger of porosity is very small.

When silicon-copper is used, add 4 ounces to the hundred pounds of brass before the metal is run into ingots. With regard to pouring, the temperature of the metal varies according to the casting desired. Large brass cylinders should be poured, above a dull heat. Never allow the metal to become so cool that it sets around the sides of the pot and hangs stringy from the lip. The metal need not be boiling hot or smoking strenuously, but merely of a bright color, as if it had life in it

If such a casting were rolled out into a flat sheet, the molder would instantly recognize the futility of attempting to cast it with metal as cool as he often uses to run the same surface in the cylindrical form. A little thought on this point would often solve many problems of honeycombing, for when it results from dull metal, the holes are not uniformly distributed, over the surface of the casting immediately under the skin but, will often form a "milky way" all up one or more sides of the casting,

showing that the air had been entrapped at these places by the metal as it languidly flowed together.

Mention is also made of melting the metal in a cupola; now a cupola is the worst possible melting furnace, for copper or its alloys, and in the case of a yellow brass is entirely out of the question. We have seen how desirable it is to shield these metals from contact with fuel or the products of combustion, and in a cupola everything is mixed together. The cupola is used in making bronze castings, but the copper is melted alone with various safeguards, and the necessary mixture is added after the copper is tapped into the ladle, but to make successful castings requires much skill, and there are many failures.

When using the oil furnace, I suppose that some suitable flux, as for instance, fluor spar, glass, soda-ash and sand, is used to lessen oxidation, although no mention is made of this point.

TRADE PUBLICATIONS.

The Berkshire Manufacturing Co., of Cleveland, O., have just issued a very artistic catalog describing the Berkshire molding machine and showing many of its applications for the production of different classes of work. The machine is the result of much careful study and development, and the catalog shows some of the many applications for which it is suitable.

The Ingersoll-Rand Co., of New York City, N. Y., have just issued a standard size catalog entitled "Imperial" Motor Hoists and Stationary Motors, and which describes a line of very compact and efficient hoists operated by a special form of pneumatic motor. Many of the applications of the hoist to various classes of work are illustrated, and valuable information given.

The necessity for careful preparation of molding sand in foundries is just beginning to be realized in this country and to fill this demand the Thomas W. Pangborn Co., of New York, has brought out the Pangborn Improved crusher and mixer, which is fully described in a 4-page pamphlet, 6 x 9 inches, which has recently been issued. A crusher of this style can be used for a great many purposes, such as crushing iron or brass cinder for the recovery of the shot metal, crushing old fire brick for use, grinding molding sand, etc.

The Westinghouse Electric & Mfg. Co., Pittsburg, has issued a catalog, 7 x 10 inches, describing its line of starting and field rheostats, including resistance boxes.

The Case Mfg. Co., Columbus, O., has issued a catalog 9½ x 12¼ inches describing the electric cranes manufactured by this company. The catalog is very well gotten up, illustrating the different details of the cranes and the operating machinery connected therewith.

The Nernst Lamp Co., Pittsburg, has issued a small catalog, 3 x 5 inches, entitled "Lux, The Candle Maker," in which a number of pithy little articles are included, comparing modern and past conditions and showing the general application of the Nernst lamp.

The Rockwell Engineering Co., 26 Cortlandt street, New York, has issued a standard size catalog, 6 x 9 inches, describing the Rockwell heating machines for annealing, hardening, tempering, coloring, etc. These are gas-fired and manufactured to suit any local conditions.

The Chicago Pneumatic Tool Co., Chicago, has issued a publication, 4 x 9 inches, containing 32 pages, giving a history of the Franklin plant and other portions of the manufacturing equipment belonging to this company, also a list of the principal users of Franklin air compressors, showing where they are located and the number each party has installed. This list will enable any party to find where the nearest installment of Franklin compressors is situated, so that he can inspect them and see how thoroughly they are adapted to the needs to be filled.

OPEN - HEARTH STEEL CASTINGS.—X.

Cracks in Steel Castings.

By W. M. Carr.

One of the most common sources of weakness in steel castings is the liability to crack in the mold. The condition is the result of "red-shortness." It is an annoyance and a continual point of contention between the melter and the molder, each blaming the other for his share in the cause, the molder claiming the steel as it leaves the furnace is not just what it should be and the melter saying that the metal is faultily cast in the desired forms without any consideration as to the proper distribution of metal in the light and heavy sections of a casting. From the standpoint of the metallurgist the melter is at times to blame and at other times the molder, or, going further, the engineer who submits the designs to be cast.

The condition of "red-shortness" or cracks is far from obliging and may present itself at the most unexpected and inopportune times. If in a given heat of steel there should be found a number of discards among various designs because of cracks and the trouble continue for a long period, it is safe to say that the metal is not receiving the proper treatment in the furnace. If cracks appear only in one design in a given heat of steel among other and different designs, the trouble is safely due to some fault either in a molding detail or the lines of the casting. In other words a few discards in keeping with an average loss of bad castings cannot be blamed upon the metal.

As discussed in previous sections, if "red-shortness" is troublesome attempts are frequently made to reach a lower sulphur analysis, but not with success. It has been thought that in doing so the trouble might abate, because the element sulphur is given the credit for "red-short" effects and that a correction could only be found in the composition. If cracks are numerous the cause is mainly due to the flame character in melting and the way the refining is conducted. Through such conditions the metal becomes contaminated with an oxide of iron that acts in a measure precisely the same as sulphur is said to do, and what may seem strange, also, is that it is possible to deoxidize the metal to the extent that blow-holes caused by gaseous steel are practically absent, yet "red-shortness" will still be causing trouble. Numerous instances have been observed in practice which point to the fact that there must be an indefinable form of oxide (iron) that does not submit to the cleansing action of silicon and manganese as final additions. In such a case as soon as the furnace manipulation could be brought under control a very serious campaign of cracked castings was stopped without any change in design of castings, methods of molding or analysis of finished product. There could be noticed also a change in the fracture of the metal in regard to the appearance of the crystals, another evidence which could be traced back to furnace manipulation, and it in a great measure is responsible for "red-shortness" in castings, independently of the amount of sulphur initially or finally.

In regard to molding conditions and their influence upon cracks the trouble often lies in several directions. Steel in cooling contracts much more than gray-iron cast from a similar temperature. There is a point where the steel has lost its fluidity and is more or less viscous, but is without stability and will crumble under pressure. When the steel passes to a lower temperature it seems to increase in density and becomes more or less malleable. At the viscous point should there be any resistance offered to the metal while cooling and contracting, because of improper distribution of metal or absence of fillets at angles, or of a flask bar, hard core, core arbor or hard molding sand, there is danger of a separation or a crack (a crumbling of the metal) at that point where the contractive force could not

overcome the resistance of the obstacles mentioned. Should the metal be "over-oxidized" at the range of temperature where viscosity is manifest, the liability to crumble is aggravated and the castings will crack with very slight resistance from the causes mentioned.

It is not to be supposed that should the metal be absolutely free from oxide it will not crack even under extreme resistance of mold parts. The conditions of crumbling under slight pressure at a high heat, near the melting point, are peculiar to all carbon steels, therefore if the steel were ever so pure it would crack if held rigidly while cooling and contracting.

Let the metal be poorly handled in the furnace and many cracks will appear in spite of care on the part of the molder. If, however, due care is observed in the position of the gate to allow a uniform cooling of the metal in the mold, cores made of such a mixture that under the heat of the liquid metal they will crumble to dust or non-resisting masses, ample sand space between flasks, bars and projections on castings, provided molding sand of such a texture that when subjected to a high temperature it will become non-resistant, used, then, with good metal, cracked castings need not cause much worry by a low yield of salable product.

Heat - Treatment and Annealing of Steel Castings.

Under this heading it is not proposed to advance arguments as to whether or not steel castings should be annealed since some opinions are held that it is not necessary with certain compositions chemically. Rather the remarks herein will be an explanation of what occurs when cast steel is given various heat treatments.

From a theoretical standpoint all castings (steel) should be annealed. Practically it is difficult to properly undertake the operation, particularly when the tonnage may be large as then the process presents commercial considerations. If specifications are rigid it is important to carefully anneal, and it is at this point that the nub of the question arises. To keep the output parallel with deliveries would involve an extensive array of annealing furnaces, and since most foundries are without capacity to anneal their entire output, an attempt to treat all castings produced would result in a slighting of the necessary care to get the best out of the process. It is better not to anneal at all than carry it out without each casting getting a proper treatment under skillful conditions. Annealing is a waste of time and money without this proper and skillful care in the work.

In general most metallurgists view heat treatment as primarily a method to equalize or lessen strains and stresses set up in a casting during cooling in the mold especially when the shape may be complicated by intricate parts or light and heavy sections combined. True a re-heating will tend to adjust these strains but really heat-treatment is a method to procure in a casting the best possible conditions in the internal structure consistent with the physical properties.

To understand what is involved in the more advanced practice necessitates a consideration of the relation between structure, heat-treatment and physical conditions.

The internal structure or crystalline formation depends mainly upon the casting temperature and the rate of cooling from that temperature. It is known that the physical properties reflect in a large degree the size, shape and character of the crystals formed in steel castings. If a freshly fractured surface of a steel casting cooled normally from casting temperature be examined, to the eye the grain will be coarse and large. If the same casting be re-heated to a much lower temperature than that at which it was cast, say a bright red, cooled and again fractured it will be noticed that grains or crystals are much smaller and

closer than in the original piece. It will also be noticed that after the re-heating it was more difficult to produce fracture than in the first instance, the metal seemed tougher. These facts give but a hint of the potent changes set up.

The refinement of the crystals when subjected to varying ranges of temperature and rates of cooling offer interesting features which to fully appreciate, requires a delving into their

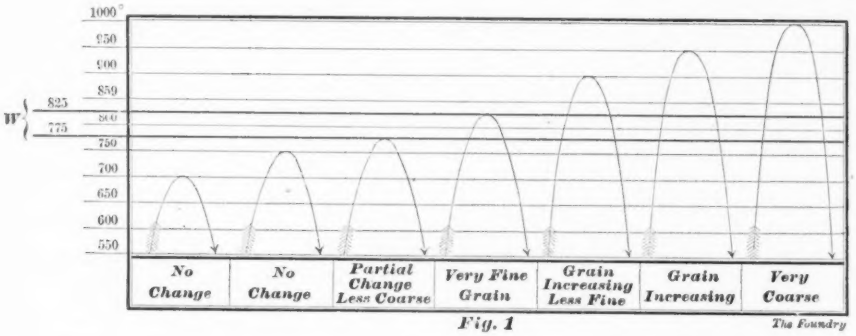


Fig. 1

details by means of a miscroscope. The microscopic examination of metals has developed a comparatively new science known as "Metallography" and with it a number of terms which apply to crystalline formations in metals not visible to the unaided eye.

Before going into a recounting of the constituents visible through the microscope and formed in cast steel, the changes produced by heat treatment upon the physical properties will be considered.

If a piece of cast steel be allowed to cool freely from a casting temperature there will be a grain or crystal growth proceeding to a certain point when the growth ceases. The metal in that condition will not possess its maximum ductility expressed as elongation and contraction of area. It will be more or less brittle, depending upon the carbon content. If that same piece of steel be re-heated to or about the point at which the grain growth stopped and allowed to cool slowly, the coarse grain developed during the first cooling will be greatly modified, broken up or obliterated and replaced by a finer grain than it had originally. In this new condition the ductility will be greatly improved; the metal will be tougher and better fitted for service conditions in any case than without a re-heating. Such a re-heating is properly speaking "annealing." The object then in annealing is to so affect the grains or crystals as to develop the maximum degree of toughness that a casting of a given composition is capable of developing.

By referring to Fig. 1, an idea will be suggested as to the changes taking place in structure by heating. The examination was made on a piece of 0.25 carbon steel possessing a coarse structure common to steel of that composition cooled normally from casting temperature. The arrows indicate the temperature to which the specimens were heated and immediately allowed to cool. The temperature was obtained in an electrical muffle furnace and measured by a Le Chatelier pyrometer. The structures were noted microscopically. The range "W" refers to recalescence or refining temperature. It is that range thermometrically at which all coarse crystallization acquired in cooling from temperatures above "W" and near the melting point is changed and replaced with a finer structure or as fine as it is possible to get in an ordinary piece of cast steel. A re-heating below "W" does not accomplish anything in cast steel. A re-heating greatly above "W" causes the grain to again grow

after it had been refined while the piece was passing through the recalescence period.

To grain-refine a piece of cast steel it is necessary to pass through and slightly above "W," and after that point has been reached nothing is to be gained by a prolonged or higher heating. That is to say, if the piece is heated throughout at the needful refining temperature the fire may be drawn or if the shape will permit it, it can be air-cooled immediately. In doing so all stresses will be minimized and no matter what the previous structure may have been, the irregularities of original stress and grain will be removed by heating the mass to a uniform color (slightly above "W") and then allowing it to cool uniformly.

The equation of time for grain refinement depends largely upon the size and shape of the piece; a wire may be brought to the right heat in a few moments. Then it should be withdrawn because a longer heating is needless. A cube 8 inches or more in section might take several hours to refine it and heat it through, but as soon as uniformly heated and refined there is absolutely nothing to be gained by heating further. Longer heating would result in grain enlargement, a decrease in ductility, toughness, a heavy scaling of the piece and a superficial de-carbonization as in malleableizing if "W" is greatly exceeded. To sum up the question of temperature and its effect upon grain size Prof. Sauveur says:

(1) "When a piece of steel, hardened or unhardened, is heated to the temperature 'W,' all previous crystallization however coarse or however distorted by cold working, is obliterated and replaced by the finest structure which the metal is capable of assuming."

(2) "The higher the temperature above 'W' from which the steel is allowed to cool undisturbedly the larger grains."

(3) "The slower the cooling from a temperature above 'W' the larger the grains." "The Metallographist," Vol. 2, pp. 265 x 266.

So much for temperature and cor-

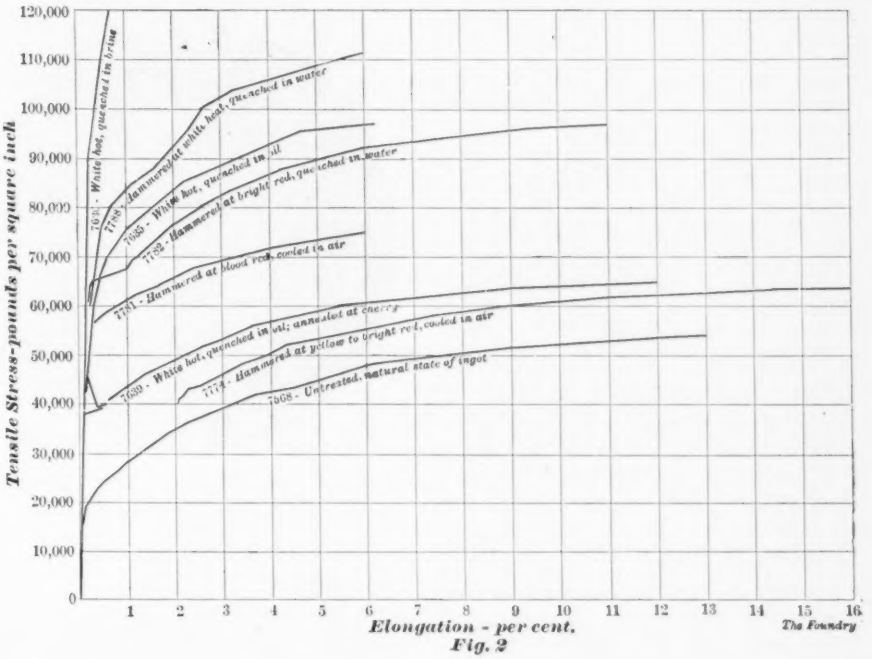

Tensile Stress-pounds per square inch
120,000
110,000
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Elongation - per cent.
7630 - White hot, quenched in brine
7748 - Hammered at white heat, quenched in water
7688 - White hot, quenched in oil
7739 - Hammered at bright red, quenched in water
7731 - Hammered at blood red, cooled in air
7689 - White hot, quenched in oil; annealed at cherry
7714 - Hammered at yellow to bright red, cooled in air
7608 - Untreated, natural state of ingot
The Foundry

Fig. 2

responding grain growths. The matter in Table 1 is selected from averages obtained in researches conducted some four years ago by the writer upon the effect of grain size as affecting the physical properties of cast-steel:

TABLE I.

Tensile strength, pounds sq. in.	Elongation, per cent, in.	Contraction, per cent, in.	Treatment.
		SERIES I.	
80385	13.26	16.2	Metal as cast.
78767	27.20	40.4	Heated to "W."
79422	14.80	15.3	Greatly above "W."
		SERIES II.	
77779	26.5	28.5	Metal as cast.
74504	25.0	48.8	Heated to 830 degrees, quenched, reheated to 750 and air cooled
78792	25.0	34.3	Heated to 815 degrees one hour and air cooled.
74058	25.7	31.	Heated 24 hours at 850 degrees. Cooled in furnace. Four hours in heating. Eleven hours cooling.
73376	24.2	26.7	Heated 36 hours between 850 to 900 degrees. Heating up 3 hours 15 min.. Cooling down 9:45.
90400	2.5	3.	Heated to 1200 degrees and quenched.

In the foregoing Series I are the averages of a number of bars from the one heat of steel and Series II from another heat. A study of the figures will readily show what can be done in arriving at different physical properties by varying the heat-treatment. Reference to diagram Fig. 2, which is a record of some extreme tests carried out by the U. S. government at Watertown arsenal, will still further enlighten one as to the contrasting behavior physically affected by heat treatment. These experiments in conjunction with others on record show, that, unless the heat-treatment is a constant and other conditions normal in steel casting practice, it is not possible to readily forecast, by means of formulas, the physical properties taking into account the chemical composition.

The ranges of ductility and tensile strength seemingly vary with temperature and rate of cooling. The treatment that will give the maximum degree of elasticity combined with the maximum degree of ductility is the one that should be aimed at in high grade product.

The strength or elasticity depends upon the amount of carbon present and the form that it assumes as a result of the heat treatment it may receive.

Ductility depends upon the smallest possible degree of refinement or non-crystalline formation structurally that the carbon-iron alloy is capable of assuming. These refinements control the annealing or heat-treatment methods and satisfactory results cannot be obtained in practice without an observance of the laws governing them. The process can best be studied with the aid of a microscope. Photomicrograph Fig. 3 is a view showing the structure of .25 C. cast steel magnified 190 times. Fig. 4 shows the same steel heated to 1,200° and cooled slowly in the furnace. Fig. 5 same steel heated to 1,200° and air cooled. Fig. 6 same steel heated to 825° and air cooled. All photomicrographs are magnified the same, and a study of the various formations in conjunction with the physical properties as tabulated will show plainly what is accomplished in cast steel by heating and cooling differently. Figs. 3, 4 and 5 are all coarse and more or less brittle. Fig. 6 shows the refinement obtained at "W" and with it will be found physically a great im-

FIG. 3.—SPECIMEN OF CAST STEEL IN CONDITION AS CAST. (AIR COOLED.)

provement in ductility. In each case the composition is precisely the same since each specimen was cut from one bar of steel.

Some attention will now be given to

FIG. 4.—SAME STEEL HEATED TO 1,200° C (2,192°F) AND COOLED SLOWLY IN THE FURNACE.

the constituents recognized microscopically in steel.

First in order comes "Ferrite" which may be seen in the submitted photomicrographs by the white areas.

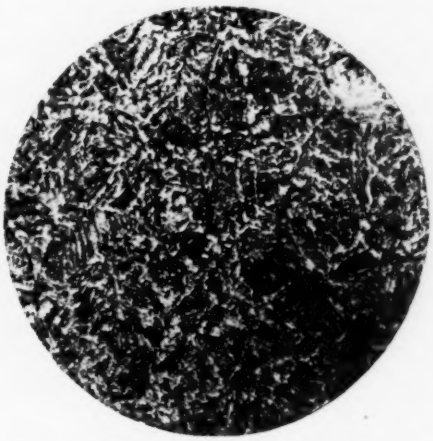


FIG. 5.—SAME STEEL HEATED TO 1,200°C (2,192°F) AND AIR QUENCHED.

It is nearly pure iron, that is, carbonless (plus Si. S. P. and Mn.). It is soft, weak and ductile.

Next in importance is "Cementite" and which is not free or visible separately in ordinary cast steel. It is the carbon iron alloy and is expressed definitely as Fe_3C. It is that constituent which confers hardness, elasticity and strength upon steel.

Finally there is "Pearlyte" which is distinguished from "Ferrite" by the dark areas shown in the photographs. It is a mixture or combination of "Cementite" and "Ferrite" in the proportions of 1 to 6. The constituents as named are the only ones that enter in the problems of annealing cast steel. (There are others, such as Martinsite, Troosite, etc., which are only found in steels that may be hardened and tempered.) Cementite is not structurally free until the carbon exceeds 0.9 per cent. Pearlyte is recog-

FIG. 6.—SAME STEEL HEATED TO 800°C (1,472°F) AND COOLED IN AIR. AN IDEAL STRUCTURE FOR STEEL CASTINGS.

nized as existing in three forms. In photomicrograph Fig. 3 it is called "lamellar" and is always found in steel slowly cooled from a high temperature (in this case from casting temperature nearly 1,600°). Fig. 4 indicates also cooling but from a lower temperature. The structure is still "lamellar" but not distinctly so. Fig. 5, cooled at a quicker rate (air quenching) but from the same temperature as Fig. 4 is called "sorrbitic" pearlyte. The physical properties accompanying such a structure would be slightly stiffer than in Fig. 4 with about the

same ductility. In Fig. 3 the ductility is low but with a higher tensile strength than Figs. 4 and 5, Fig. 6 gives a view of "granular" pearlyte and is the one sought when ductility and resistance to shock is necessary. The tensile strength with such a structure is slightly lower than those of the preceding. In the last structure we have a view of the marked change that has occurred by a heating to "W" when the previous structure was as shown in Fig. 3 and also what occurs in grain growth in the other photographs when the temperature is carried far above "W." Were the temperature increased to or about 1,500° there would have been in Figs. 4, 5 and 6 about the same formation as in Fig. 3.

A study of Fig. 3 reveals a reason why cast steel unannealed is more or less brittle and snaps or fails suddenly in shock or impact. The dark areas or the carbon compound is comparatively hard, while the light or carbonless areas are weak and there is an uneven distribution of the strong and weak parts so that the ferrite areas offer planes of cleavage under stress.

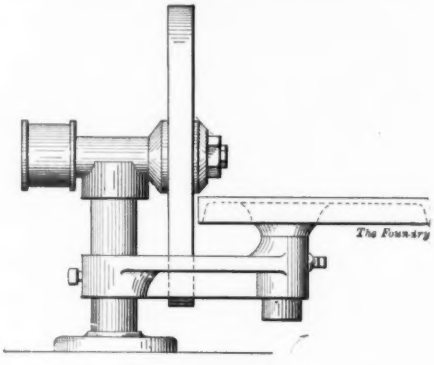
When the structure is broken up as in Fig. 6, the crystals are very small with an even intermingling of the several constituents with cleavage planes practically reduced to nil. A fracture occuring in cast-steel with a coarse structure always follows the ferrite areas and it is not known that the line of separation passes through the pearlyte. A coarse microstructure usually accompanies a coarse fracture while a fine microstructure will show a fine, silky fracture.

In order to study the structures microscopically means a careful preparation of the specimens and a high powered instrument with several necessary appurtenances. If the reader wishes more detailed information in this branch he is referred to Sauveur's writings in the *Metallographist, The Iron & Steel Magazine* and also the columns of THE FOUNDRY.

POWER ATTACHMENT FOR A CORE MACHINE.*

By W. O. STEELE.

In the original equipment of the foundry of the Bateman Manufacturing Co., a Wadsworth core machine held prominent place. The possibilities of the machine core appealed very strongly to the writer, and while we experienced some difficulty in getting the kind of cores we needed, we persisted because of the immense ultimate saving if we succeeded. We were shortly rewarded by what, at that time, we considered a perfect core. The excellent results obtained from these cores led us to continually experiment with the view of greater perfection, until

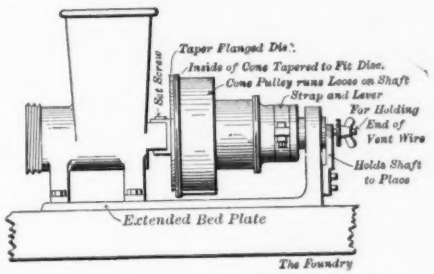


SPECIAL EMERY STAND FOR CONING CORES.

eventually many reamed holes gave place to this new kind of core, thus making a great saving in the machine cost of our product and obviating the necessity of putting new machines in already cramped quarters. This spring the company put a new machine into the field that demanded more machine cores than any of its predecessors, partly from its different nature and partly from the fact that it was designed with the knowledge of machine core possibilities. We met the requirements handsomely, effecting a very marked economy in producing the machine. The demand for this new machine, which, by the way, is a potato digger,

*Paper read before the Philadelphia Club of Associated Foundry Foremen, Sept. 10, 1906.

was simply phenomenal and the capacity of our hand-operated core machine was not equal to the task set for it, nor was it possible for the two experienced men we had to cut and cone cores fast enough to keep up with the procession. This led to the installation of an electric motor for operating the machine. We made a special emery stand to take care of the coning and grinding to length. Then came the problem of applying power to our core machine, the requirement being that it should be so arranged that it might be instantly started or stopped—a requirement too exacting for a shifting belt. All the core machines now on the market, either hand or power, are, so far as the writer knows, geared. This was not desirable,


Taper Flanged Disc
Inside of Cone Tapered to Fit Disc.
Cone Pulley runs Loose on Shaft
Strap and Lever For Holding End of Vent Wire
Set Screw
Holds Shaft to Place
Extended Bed Plate
The Foundry

POWER ATTACHMENT FOR A CORE MACHINE.

so we removed the old hand wheel with its gears and shaft and extended the bed to include an outboard bearing. In place of the driven pinion on the screw shaft, we put a disc with a beveled rim. This disc was set screwed fast to the new shaft. Adjacent to this we put a two-step cone pulley, the larger pulley next the disc, the inside of rim turned to the same angle or bevel as the outer rim of the disc. This cone ran loose on the shaft, the end farthest from the disc being provided with a groove and a strap fitted into it, with a convenient handle attached. To start the machine it became necessary simply to move the cone by means of the handle to engage with the disc, practically a friction clutch pulley, but one in which the movement to engage and disengage it was but a fraction of an inch—less than one-eighth, as a matter of fact. This rig was inexpensive and works perfectly and has just doubled the capacity of the machine, as did the emery stand the capacity for fitting and sizing the cores. The core machine is operated by a two-inch belt, at 535 revolutions per minute. We put the cone on to meet emergencies, but found this speed sufficiently fast for the smallest core (three-eighths inch) and not too fast for the largest we make (one and three-fourths inch). Holes equal to reamed holes are made in the castings by the use of cores turned out with this equipment, many being but one-sixty-fourth inch larger than the cold rolled shaft on which the casting revolves, or, vice versa, in which the shaft revolves.

The Independent Pneumatic Tool Co., Chicago, has issued a 4-page folder, 9 x 12 inches, describing the Thor tools, which include both hammers and drills.

The Electric Controller & Supply Co., Cleveland, is sending out a very neat panel, in the center of which is mounted an embossed figure of a lady's head, entitled "Laurie." This is mounted upon a black mat and the name of the company printed in the lower right hand corner.

The Osborn Mfg. Co., Cleveland, O., has just issued a new catalog, entitled "Catalog No. 122." It is standard size, 6 x 9 inches, contains over 200 pages and covers an extensive line of foundry supplies, in addition to the well known line of brushes manufactured by this company. Among some of the specialties illustrated are the "Economy" steel wire brush which has been developed by the Osborn Mfg. Co., and a full line of forks, shovels, riddles, pails, steel barrels, chaplets, fillets, flasks, wheelbarrows, trucks, cars, and other foundry appliances. For the use of cleaning brushes and wheels a line of grinding stands is illustrated. The catalog also contains many appliances, such as the Buckeye core oven, sand mixing and tempering machinery, tumbling barrels of various types, foundry ladles, molders' tools, etc.

THE PATTERN SHOP

A BEVEL GEAR PATTERN.

By H. J. McCaslin.

When the axes of a pair of gears meet at an angle they are termed bevel gears. When the axes are at a right angle and the gears are equal they are called miter gears. In other words, a miter gear is always a bevel gear, but a bevel gear is not always a miter gear.

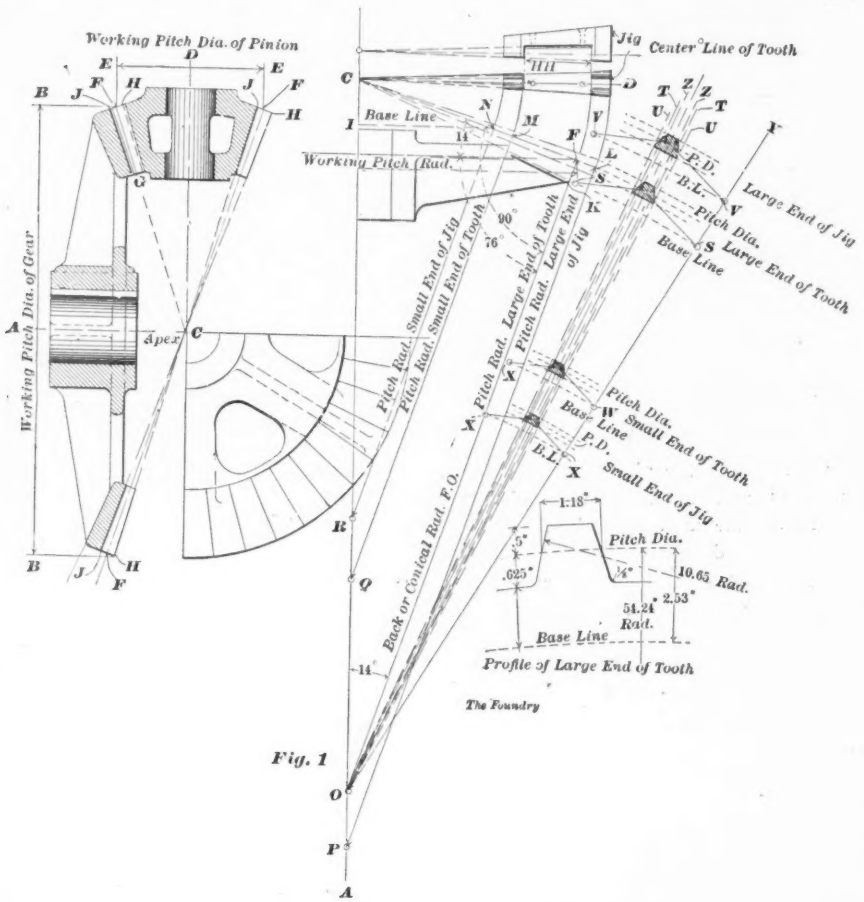


Fig. 1

To cast a pair of miter gears which will mesh and run together only one pattern is required, while to cast a pair of bevel gears as shown in Fig. 1, two patterns are necessary, because the angle of each gear is different on the face, and also each contains a different number of teeth. In a pair of miter gears the face angle is the same on both gears and the number of teeth the same.

The working pitch diameter of a bevel gear, or of any gear, is the circle upon which the circular pitch of the gear is measured This circle is also used in all calculations to determine the rela-

tive velocities of the pair of gears.

The circular pitch of a gear is the distance between corresponding points or the center-to-center distance of adjacent teeth measured along the pitch surface.

In beginning the discussion let us assume that the pattern to be laid out and made is that of a 15-degree involute short-tooth bevel gear, having a pitch diameter of 36.605 inches, 46 teeth, 2½-inch circular pitch, and a five-inch face. The angle formed by the center line of the tooth and the plane of the pitch diameter is 14 degrees.

Laying Out Gear.

To make a full size lay out of a pair of bevel gears, as shown in Fig. 1, draw at right angles to each other the axes A-C and D-C intersecting at the apex C. Lay off the working pitch diameter B-B of gear, which is equal to 36.605 inches and the working pitch diameter

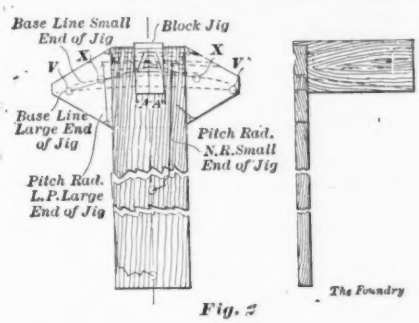


Fig. 2

of the pinion, which is equal to 11.936 inches. Now, from the pitch point F, or the point of intersection of the two pitch radii, draw the center line of tooth F-C. Lay off F-G equal to the given face, which is five inches, and draw both ends of tooth at right angles to the center line F-C of tooth. Lay off F-H equal to the given addendum 10.5 inches and F-J equal to the addendum plus the clearance, which is equal to 0.5 inches plus 0.125 inches = 0.625 inches. Draw the face line H-C and the root line J-C of tooth. It should be noted that all lines on the face, whether at the top or bottom, or any point on the sides of tooth, including the base line, all terminate or meet at the apex C. With the drawing in of the web, hub, etc., the lay out is complete. The gears, of course, are symmetrical about their axes, and so a one-half lay out is all that is required.

Obtaining the Profile of Tooth Ends.

Shown to the right in Fig. 1 is one method of obtaining the profile of each end of the tooth and also of the jig. The jig as shown at the top of the figure is employed in sanding the tooth to form. The tooth profile for an ordinary spur gear is determined by the number of teeth contained upon the circumference of the working pitch diameter, while the

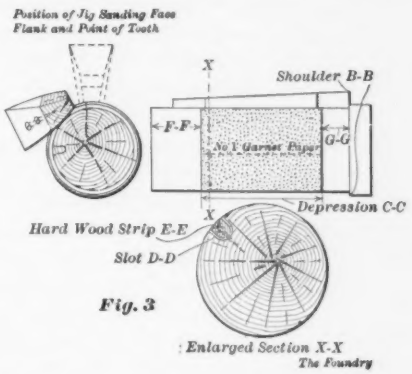


Fig. 3

profile of a bevel gear tooth is determined by the number of teeth contained upon the circumference of a circle, the radius of which is equivalent to the back or conical radius, F-O. This radius is the conical pitch radius of the large end of tooth. The lay out of gear having been executed as explained, lay off the distance F-L and M-N equal to about two inches, and draw the back conical radii F-O and L-P, M-Q and N-R at

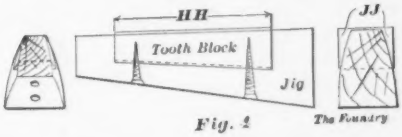


Fig. 4

right angles to the center line of tooth F-C, and intersecting the axes A-C, as shown. With O as the center, and F-O as a radius, which we find to be equal to 76.07 inches, draw the back pitch diameter and lay off the given addendum, root and thickness of tooth, which is 1.18 inches. Next calculate the base circle, which is equal to 2.535+ and lay it off as shown by F-K and draw the line K-C. As the base circle or the circle from which the face and flank of the tooth is scribed, for a 15-degree involute

tooth, is inside the pitch diameter a distance equal to 1-60 of the pitch diameter, it is obtained as follows: 76.07 inches × 2 = 152.14 inches ÷ 60 = 2.535+ inches.

As the tooth profile is based upon the number of teeth contained upon the circumference of the back pitch radius F-O it should be calculated as follows: radius F-O = 76.07 inches × 2 = 152.14 inches diameter, multiplied by 3.1416 = 477.963+ inches circumference, divided by 2½ inches circular pitch = 191 +. The number of teeth contained upon the circumference of the back pitch radius F-O. In dividing the circumference of the back pitch radius by the given circular pitch of gear to obtain the number of teeth contained therein, for selecting the radii for drawing the tooth curves, it is seldom that the circumference will divide without a remainder. This fact, however, affects nothing, as it does not materially alter the form of tooth in a gear of this proportion, by selecting one or two teeth, more or less for drawing the profile.

By referring to the odontograph table we find the radius to be used in drawing the face and flank of tooth for a gear of this number of teeth (191) is equal to 10.65 inches. The centers S-S are now

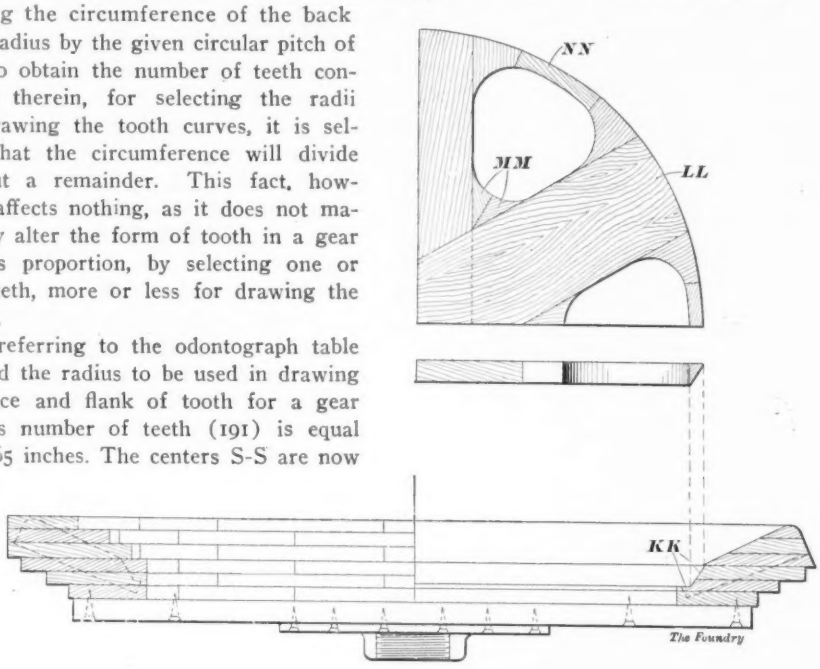


Fig. 5

determined upon the base line and the profile of the large end of tooth drawn as shown. Using O as a common center, scribe the pitch radii N-R and M-Q and L-P, with their corresponding base lines. Next through the thickness of tooth at point, pitch circle and root, draw radial lines Z-O, T-O and U-O, which will give the proportion of tooth at their respective stations, which will be the large and small end of jig and the small end of tooth. Through the radii points S-S draw radial lines Y-O, which will determine the centers V-W-X, to be used in drawing the face and flank of tooth corresponding to their stations.

Frequently bevel gears assume such proportions that it is not convenient to determine the length of the back conical radii by a lay out. When such is the case, calculations for these dimensions can be made as follows, which assumes the form of a simple example in trigonometry. Given one angle and side of a right angled triangle to find the length of the hypotenuse. The solution is simply this: Divide the length of the given side by the sign of the opposite angle. Suppose we wish to calculate the length of the back radius F-O of the gear under discussion. Knowing the angle formed by the center line of tooth F-C and the plane of the working pitch radius, which is 14 degrees, an angle of the same number of degrees will also be formed by the axes of gear A-C and the back radius F-O, which places our example in the following form: The working pitch radius, which is equal to 18.3025 inches, divided by the sign of 14 degrees. This, looking up the table of natural signs, is equal to 0.24192. 18.3025 inches ÷ 0.24192 = 76.07 about, length of back ra-

dius. To determine the length of any of the conical radii, say N-R, all that becomes necessary is to measure the distance N-I upon the lay out and divide this distance as before by the sign of the opposite angle, 14 degrees.

Laying Out the Jig Block.

The rig and method employed in holding the material or block is shown in Fig. 2, from which the tooth jig, as shown at the top of Fig. 1 and in greater detail in Fig. 4, is made. The rig simply consists of a board, upon one surface of which the conical radii N-R and L-P, with their corresponding base line, are carefully drawn and the face and flank radii centers V and X laid off upon the base lines for drawing the profile of tooth at the large and small ends of the jig. The slot A-A in center of the board is now cut out to receive the jig block, the latter being shown in position. The material or block for jig having been gotten out of hard wood, cherry or maple preferred, the two sides and one edge are dressed true to each other, this being necessary so that the block will fit the slot A-A accurately. The block is now inserted in the slot and the profile of one end of the jig carefully drawn. The block is now placed in the slot in the reverse position and this end of the jig drawn. The surplus material outside of the end profiles is roughed off, and the exact outline of the jig carefully and accurately dressed up and the opening H-H in the center cut out, as shown in Fig. 4. Fig. 3 illustrates two views and a cross section of the sand roller or mandrel, with the jig in two positions during the operation of sanding. The roller is turned up of any convenient diameter, say 4 to 4½ inches, with shoulder B-B at one end for guiding the jig. A depression C-C of about 1-16-inch in depth and in width a little larger than the length of tooth, is now turned down and a piece of garnet paper cut to the length C-C and secured to the roller by the aid of the slot D-D and strip E-E. This manner of securing the paper to the roller has a decided advantage over gluing, as the paper is readily replaced without the usual delay waiting for the glue to set. It also avoids the trouble apt to occur by the paper swelling or buckling by the moisture from the glue.

The dimensions F-F and G-G, which are of sufficient width to give a good bearing for the jig, are now turned down on a line with the garnet paper, or to the same diameter. The completed jig is shown in greater detail in Fig. 4, the opening H-H in the center being cut out to receive the tooth blocks. The latter is shown in position and is secured in place by two screws. As the bottom of the tooth block must conform to the diameter of the rim of the wheel upon which the teeth are placed, so must the bottom of the opening H-H in the jig be identical with the same diameter.

Sanding the Teeth.

With the jig and roller completed the sanding of the teeth takes our attention, and this is a good job for the cub. The tooth blocks having been gotten out of sufficient width, both ends are trimmed to the exact length and angle, and next with a round sole plane, or the bit in the jack plane rounded up. The edge of the block is dressed up to conform to the bottom of the opening H-H in the jig. The tooth block is now placed in the jig and secured with the two screws, and after the cutting off with a chisel of the surplus material at the corners J-J of blocks, the sanding follows in order.

Controlled by the shoulder B-B, Fig. 3, the jig is held against the roller and guided over it as it revolves.

Making the Body of Patterns.

Fig. 5 illustrates two cross-sections of the rim in the course of completion, also a part plan and cross-section of the web. To the left of the center line is shown a cross section of the segment work prior to turning, which also shows the manner in which it is built up on the face plate, while to the right of the center line is shown a cross section of rim at the completion of turning the back or inside of the rim, the offset or shoulder K-K being turned down to receive the web. A portion of the latter is shown directly over and in position for placing into the rim. The three pieces of material, one being shown by L-L,

which form the greater portion of the web, are overlapped and secured together with glue and screws. The corners M-M and segments N-N are fitted in place and glued. This portion of the pattern is now secured to a face plate, and the outer diameter turned to fit snugly into the shoulder K-K of the rim, in which position it is secured with screws and glue. It will be found more convenient if this web portion of the pattern is gotten out first and the outer diameter turned to shape, and the offset, or shoulder, K-K, in the rim, turned out to fit the web, and the latter can then be secured in place before removing the rim from the face plate. The back of the rim is then given a coat of shellac and sandpapered down and removed from the face plate, turned over and centered and chucked directly upon the web of pattern, as shown in Fig. 6. This illustration shows one manner of accurately placing and securing the teeth upon the rim.

The face of the rim or the root of the tooth line is now turned to the required angle with the aid of a templet, which should extend across the entire diameter of the rim. Next attach to the web at the center of the work, as shown, the block or post P-P. The post should extend far enough out to allow the apex of a cone, of which the rim is the frustum, to be turned at its outer point, S-S. If the face angle of rim is correct, the

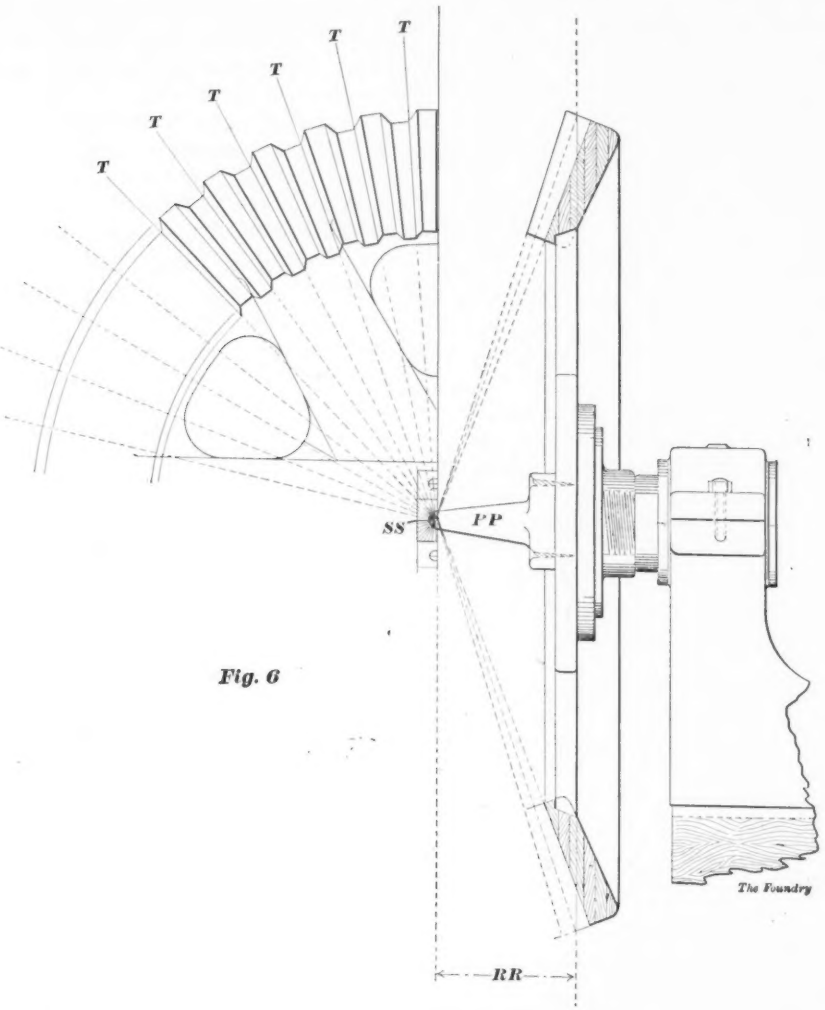


Fig. 6

distance R-R from the plane of the pitch diameter of wheel to the apex of cone thus formed should be equal to the pitch radius of pinion. Spaces corresponding to the number of teeth are next spaced off on the face of the rim, near its outer diameter. The lines T-T-T are now drawn across the face of the rim through the points stepped off and intersecting at the point S-S of post. In placing the teeth on the rim, glue is applied to the tooth and the side of the tooth is set to one of the lines T, in which position it is held for a moment until the glue slightly sets. The sides and top are then tried for accuracy with a straight edge, for if the tooth has been accurately set, all lines of the tooth should intersect at the point S-S. The spaces should also be tried for correctness, with the calipers from the adjacent tooth. When all the teeth have been so placed and their correctness assured, they are nailed down and a leather fillet rubbed in. With the getting out of the hub and ribs and the remainder of the pattern, our work is completed.

MULTIPLE CORE BOXES.

By H. N. Tuttle.

A few months ago a method of drilling multiple core boxes was described in The Foundry. This method could be applied only to round cores, either straight or with one taper print. In shops where it is customary to taper both prints, some other way must be resorted to. There are several ways of making these boxes, a few of which will be discussed here. A wood master pattern may be made and cast, but this is not as accurate as the following, unless great care is taken in making the pattern.

When a plaster of Paris pattern is made, the wood cores may be made solid (that is, not split). The required number being varnished, oiled and laid upon a board, strips BBB and CC (Fig. 1) are placed between them, of a height equal to the radius of the cores, so as to bring the parting right. CC are made wider, to give stock for the dowel pins. The frame DD is now placed around the cores to contain the plaster.

In mixing, it is advisable to sift the plaster into the water, stirring at the same time, rather than pouring the water into the plaster. Plaster workers say that it works smoother and better when mixed this way, and is not so liable to prematurely set. They also say that any sweet substance, as molasses, or any sour, as vinegar, may be used as a retardant. Nearly as much water should be taken as is desired of the mixture. The plaster, rather thick, should be poured over the cores, care being taken to prevent their floating, and when covered about ⅛ inch, a piece of coarse wire screen, such as a piece of old riddle bottom, should be bedded into the plaster (E, Fig. 1). This netting will hold the pattern together, should it be cracked from dropping or careless handling. The rest of the plaster is now poured and struck off, allowing about ⅜ inch stock over the cores.

When the plaster is sufficiently set, the rim is removed and the cores marked in their places, and also removed. The joint or face of the pattern is now trued up and the wood cores replaced in their respective positions. After thoroughly oiling the rim is replaced, and another plaster pattern made upon the first. In this way there is made a pattern for each half-box, which is done to insure perfect registry of the halves.

If it is decided to make only one half pattern, using split cores, which should be split before turning, they should be not only accurately spaced, but should also be placed in such a manner that when the two halves of the box are put together, the mold of each half core will coincide with the mold made by the other mating half, which was turned with it. This is illustrated in an exaggerated way in Figs. 2 and 3. A and B are the two halves of one pattern (Fig. 2), C and D of another, and E and F of the third. Now if placed as in Fig. 3, when the two halves of the box are brought together, A will mate with B, C with D and E with F. It will thus be seen that if the patterns are not turned with the parting exactly in the

center, it will not affect the accuracy of the cores. If there is to be an odd number of cores in the box, the odd center core should be chosen from a pair whose halves caliper exactly alike.

The plaster pattern being ready, a shallow wood box is made, somewhat larger than the pattern (Fig. 4). The pattern being laid in this box, as shown, a core made of the finest molding sand and oil is rammed up by the coremaker. Windsor Locks sand makes very fine cores, though any fine brass molding sand will be satisfactory, The two cores

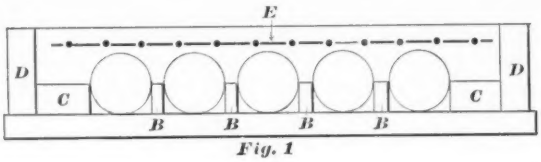


Fig. 1

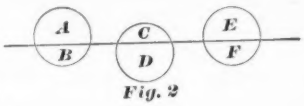


Fig. 2

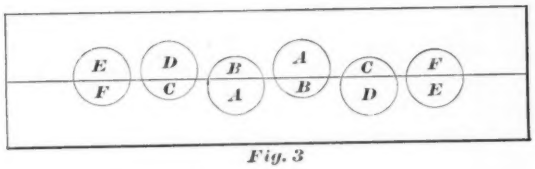


Fig. 3

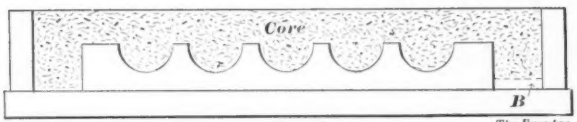


Fig. 4

having been baked and the gates filed in, as shown at B, they are ready for molding. They are placed upon the bottom board of a snap flask, face down, and the drag rammed. After the drag is turned over, a cope, which has been rammed up on a smooth board, is now placed upon the drag, when the mold is ready to be poured. The cores should not be black-washed, as this seems to pit the surface of the casting. Boxes made in this way will come out very smooth, requiring but little filing or scraping.

The drilling method is advisable when a very accurate core is required. Six castings are required, two each of A, B and C (Fig. 5), in which D equals the length of the cope print, F the length of the drag print, and E the length of the body of the core. The width and length of these pieces will be governed, of course, by the case in hand. If it is decided to plane the pieces, stock for finishing should be added, but this is not usually necessary. The pieces are fastened as shown in Figs. 5, 6 and 7, with ¼-inch countersunk, flat-head machine screws, care being taken in locating these, so they will not be in the way of drilling out the cores.

After the box is doweled together, it is spaced, and the lead hole drilled as described in the previous article. Pieces A are now removed and the body of the core and the drag print are reamed out, using the lead hole to guide the reamer. The pieces A are then replaced and pieces C removed. The cope print is now reamed. Fig. 3 represents part of a finished half box and Fig. 7 an end cross section, showing the ¼-inch machine screws.

These boxes may be drilled without the joint between B and C (casting these two pieces in one) by drilling the lead hole through the assembled box, then separating and working both ways from the joint. It was found upon trial, however, that this did not give as accurate results, as the reamer did not always run exactly concentric with

the lead hole, so that the cope prints did not exactly register with the body of the cores. The inaccuracy was slight, and need not be taken into account, except where very accurate cores are desired.

Often, when drilling two pieces together for dowel pins, it is advisable to sprinkle a few grains of emery in the joint to prevent the halves "shucking."

When making multiple boxes for pocket cores it is customary to part the box along the line AB (Fig. 8). Parted

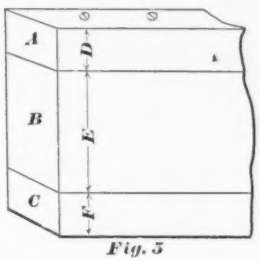


Fig. 5

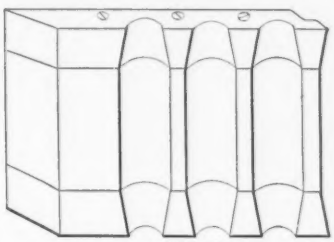


Fig. 6

Fig. 7

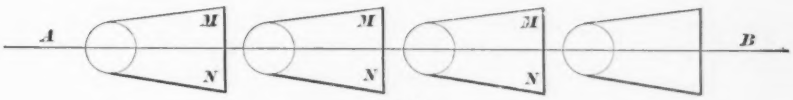


Fig. 8

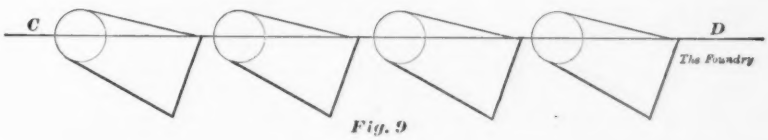


Fig. 9

in this way there is a tendency of the corners M and N to tear off, since the line MN is perpendicular to AB. By parting the box on line CD (Fig. 9), which is a line drawn through the center of the hole to one corner of the print, this trouble is overcome.

In regard to the cost of making multiple core boxes, it might be mentioned that a "batch" of 24 boxes of various kinds recently finished here cost $23 for labor at 30 cents per hour; about $1 each.

It might not be out of place here to speak about the number of cores which can be made in multiple boxes in a given time, as there are many core rooms which do not contain a single multiple box. From one drilled box, making cores 11-16 inch in diameter by 2 inches long, 9 cores to the box, 2,500 cores were made per hour, or over 40 per minute. I do not think that the best core machines are claimed to make more than half as many. It should be said, though, that these cores did not require venting, which would have taken somewhat longer.

Concerning pocket cores, from one box making 9 cores, each about one inch long, 99 cores were made in 4½ minutes. Pocket cores cannot be made as fast as straight, round cores on account of the necessity of filling the corners.

About the time, as mentioned above, for making cores, I do not know whether it would be considered a creditable performance on the part of the coremaker or not, as I am not a core maker or a molder, and do not know whether the man who made the cores was considered fast or slow, but merely give the results which I obtained from the core maker.

The main features to be observed in making multiple boxes, especially for pocket cores, are, to make them perfectly smooth, so that the oil will not stick to them and gum up, have all the wire edges and corners scraped off, no

Side Elevation
Flange loose on pattern
B
C
Core Print
A
Flange loose on pattern
Fig. 1
Fig. 3
Core plate
Ribs
Core box
The Foundry
Fig. 2
Plan
Parting line of pattern
Core Print
Loose piece
Front Elevation core prints removed
Fig. 4

places giving the slightest trouble in drawing, and, above all, getting as many cores as possible in a given length of box, which should correspond to the drying plates used in the core room. If the box happens to have been made too thick on the edge, the corners may be ground off, so it will cut into the sand nicely when in use.

The number of the boxes should be stamped with steel stamps in such a position that the thumb and fingers of the core maker will rub across it when in use, which will prevent it getting covered up with the gum which always collects elsewhere on the outside of the box.

THE MAKING OF A CROOKED ELBOW.

By Jabez Nall.

Life is made interesting for the patternmaker at times by the various problems, mechanical, geometrical and otherwise, which are presented to him for solution in the course of his daily duties. The making of the elbow described in this article presented a few of these to the writer some years ago. This elbow was made to connect with a rectangular pipe 6 x 9 inches, which passed around a cylindrical body with a flat, conical head having an opening 7 inches in diameter. Metal thickness was specified as 3-16 inch, but the patternmaker and the molder between them probably increased this a little by the process known as playing safe. The variation, however, was not more than 1-16 of an inch, as weight was an important item. In producing a pattern of this character, or, in fact, in producing any pattern, the first consideration with the practical patternmaker is the manner of molding it. Notwithstanding the opinion of our friends, the molders, to the contrary, a goodly number of patternmakers are wearing gray hairs (when they are not bald headed) from worrying over this very question of the moldability (to use a newly coined word) of patterns.

Of course we are told that we are to consult with the foreman molder, but how many foreman molders, if shown this elbow as projected in the three views, Fig. 1, could tell you just where or how to mark the parting line, which is the first thing to determine in order to avoid the waste of lumber in gluing up the necessary block from which to make the pattern. The first piece should be large enough to include all of the curved part of the pattern, the end flanges and core prints being made separate and as these latter are of known shape and dimensions they are an easy proposition and when finished can be screwed to the main portion of the pattern. Lines A and B, while not a true projection, will give the average patternmaker a better idea of the method of parting this pattern than the projection lines would.

The material being glued up for the several parts, the part for the drag or lower half of the pattern is then cut to conform to the parting line. To aid in this work free use should be made of the surface table if you are fortunate enough to possess one, or a trued-up board can be made to answer if no surface table is at hand. This will result in a saving of both time and lumber, especially if the patternmaker can secure a surface gauge of sufficient size from his friend, the machinist, for it is not likely that one will be found in the pattern shop equipment, though it should be there. By clamping the base of the surface gauge to the table, it is easy to turn it into a sliding trammel which can be raised or lowered at will and still keep the same radii, the stem being set up perpendicular to the face of the board. This makes it easy to lay out many lines, even on a rough surface, and to do it in shorter time than can be done by projection. It is also accurate.

You will notice that the parting line has to be twisted at the round end of the pattern in order to make it possible to place the core into the mold in one piece and also to produce a pattern with as few loose pieces as possible. It will be found easier to make this part from the bottom of the slope (line C, Fig. 1), separate and then set it to the correct angle and screw it in position, after which the

bevel from this to the main line of parting can be worked out. This being done, the upper or cope half of the pattern is then fitted to the lower half, forming a complete joint, and the two doweled together. Next, the form of the pattern is laid out on the joint and the two parts are finished together. In this work we must again depend upon the surface plate to make sure that there is no back draft, care being taken to place the pattern in exactly the same position each time it has to be removed from the surface plate.

It is necessary that the flanges be loose from the body of the pattern, on account of the angle at which they are placed and the curve that fits the cone. Otherwise it will not be possible to draw the pattern. These loose pieces should be placed in a groove, in order to insure their staying in position while ramming and also to give them strength. The portion of the upper part of the pattern marked "loose piece" should also be doweled on separately, as the angle of the end is such as to prevent a straight draw.

In making the core box, the block of the lower half of which is shown embedded in the sand, it is first necessary to make the block, which is composed of three pieces for the body and two pieces to close up the ends. These are screwed together and fitted at the joint to the upper half of the pattern. This done the construction lines 1-1, 2-2, 3-3, etc., are marked on the pattern and transferred to the joint of the core box. The outline of the pattern is also marked by a scratch awl while it is lying in position upon the core box Another line is then made inside of this corresponding to the thickness of the metal. Templets are next made of thin pieces of wood and fitted to the pattern at the lines marked, and at as many additional places as the patternmaker thinks necessary. From these other templets are made for the core box, allowing the thickness of the metal between them, as shown in Fig. 3, which illustrates the templet for line 6-6 of the drag half of the pattern.

Before we proceed to cut out the core box, it is necessary that we provide for the requisite core plates upon which to dry the core and it is highly important that these be true to shape, as otherwise the cores will not joint up and the results will be either too thick metal or a defective casting from the cores cutting through where they should not. As a simple method to insure the shape of these plates the writer uses the block prepared for the core box as a follow board, as indicated in Fig. 2. Upon this were fitted two pieces, say ¾ inch to one inch wide, as an outline for the core plates, these pieces being 5-16 inch thick. Between them sand was filled in and swept off to the required thickness. This sand was then freely sprinkled with parting sand and upon it placed ribs, as indicated. These ribs are intended to bring the plate to a level bearing and also to strengthen it and prevent its losing its shape from the heat of the core oven. A flask was then placed over this and molded in the usual manner, first ramming up and placing the bottom board, then rolling over and making the cope half after lifting off the frame. The strips are then removed and the sand lying between them removed, the ribs drawn, and, except for the connecting gates, etc., we will have the mold for the core plate for the lower core. The same method is used for molding the core plate for the upper half.

We next proceed to cut out the core box, using the templets for this purpose, put in the finishing touches, varnish, etc., when the job is completed.

There may be other and better ways of making this same elbow and, if so, the writer would like to hear of them. One other method which suggests itself to the writer concerns the making of the core. For instance, this could be accomplished by mold-

ing each half of the pattern separately, having first built on for the metal around prints with temporary pieces, also for the ribs and flanges at the joints of the pattern. The pattern will be molded in the drag only and then withdrawn, the metal thickness being arranged by applying sand. The cope half would then be made and lifted off, the sand removed and metal core box cast. The core could be left in this core box to dry. It is probable, however, that by the action of heat and cold this core box would become distorted in time. The writer considered that upon the whole the plan adopted was the cheapest and that it was practical was demonstrated by the results obtained in the casting.

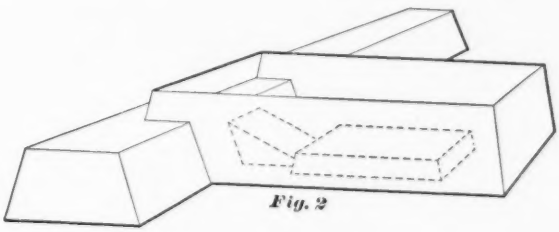


Fig. 2

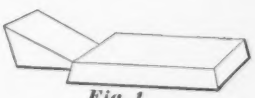


Fig. 1

The Foundry

WHITE METAL PATTERNS.

By H. N. Tuttle.

The writer was much interested in an article by Mr. C. Vickers on the above subject, in the October number of The Foundry, and would like to make mention, as merely supplementary to his article, of a scheme which can sometimes be used for making the same kind of cheap tin and antimony gates. This method can be applied only to patterns which have a flat cope, but where it can be used, it saves the trouble of making two sets of patterns, as described by Mr. Vickers. The master pattern is first prepared with a gate attached, properly beveled to fit the runner, Fig. 1. A small flask, but little larger than the pattern, is next made of four pieces of galvanized iron or brass, soldered at the corners, slightly tapered, and notched out at one end to fit over the runner, as shown in Fig. 2. The runner is screwed from the underside to the bottom board. The small flask is placed in position next the runner, with the pattern inside. (The pattern is shown dotted in Fig. 2). It is then rammed, turned over and the pattern drawn. The mold is now turned back and placed in its position at one end of the runner. The flask is now lightly rapped, and on account of being tapered, is easily lifted off. The next mold is rammed as before, and after drawing the pattern, the mold is placed beside the first. After the molds are all made, the drag part of the large flask is placed upon the bottom board around the entire gate of individual molds, and rammed, care being taken not to crush the small molds. The flask is then turned over, and the screws removed, releasing the runner, which is drawn after the bottom board is removed. The cope is rammed on a flat board, placed upon the drag, and the gate cast.

Morris Goldberger, of Fort Wayne, Ind., has purchased the Globe Brass Works, of Detroit, Mich., and is considering the moving of the plant to Fort Wayne.

The Birmingham Concentrating & Iron Co., Birmingham, Ala., has been incorporated with a capitalization of $50,000 to do a general foundry and iron business and to deal in iron castings, machinery, scrap, etc. The officers and directors are: R. H. Elliott, president; J. M. Stilwell, vice president; P. T. Whilden, secretary-treasurer, and J. J. Farmer.

CONVERTER STEEL CASTING PRACTICE.—NO. 3.

By Arthur Simonson.

Having considered in the last chapter the calculation of the cupola charge we will now follow its course through the subsequent procedure. In melting steel scrap along with pig iron in a cupola provision must be made for hot melting and a higher ratio than one of coke to seven of iron can scarcely be looked for. Cupola metal containing twenty-five per cent of steel scrap is liable to be sluggish, therefore plenty of coke must be used and an ample amount of blast. It is one of the most necessary things to ensure good hot steel in the converter that the cupola metal should be hot and clean. Some operators use a cupola of sufficient size to tap out the necessary two tons at one time, others prefer a cupola holding only one ton at a time and make two taps per blow. This has its advantages as the iron remaining a shorter time in contact with the bed of coke is less liable to absorb sulphur.

During the time the cupola has been charged and the iron melted the converter has been prepared to receive the first charge of iron. It is necessary to get it to a high heat for this purpose, in fact the hotter it is the better. There are different ways of doing this and perhaps the commonest and most satisfactory is to make a coke fire and blow it with about one pound of pressure from the blower. About two or three hours and half a ton of coke is necessary and the converter is alternately blown for fifteen minutes and turned upside down with a plate fastened over the mouth to retain the coke, and all tuyere box covers removed. This is to heat the bottom, which is not reached by the blast. It is most necessary that the bottom of the converter should be particularly hot. An oil burner or natural gas may be used and is found satisfactory by some users.

When the converter has been thoroughly heated the coke is dumped out into the ash pit and the unburnt portion recovered to be used in drying ladles, etc. The converter should be ready at exactly the same time as the iron is tapped out of the cupola. The iron is collected in a ladle and transferred to the converter, after which the latter is turned down until the iron just comes to the lip. It is then skimmed entirely free from slag and this should be done before commencing each subsequent blow. The vessel is then turned up again and as it rises the operator looks through the tuyeres from the back of the vessel and continues the rotation until the convex edge of the molten metal just appears over the edge of the tuyere. This is the most important point in the manipulation. The metal must be "up," but not in the tuyeres, and what constitutes "up" is a matter that takes some time to learn. It is well to use smoked glasses, or get the eyes accustomed to the color of the metal by watching it whilst being tapped out, poured into the converter and skimmed, otherwise it is comparatively easy to be deceived. When sure that the metal is exactly up, the position of the converter is carefully noted.

For this purpose the writer uses an indicator (as illustrated in Fig. 1) which is simply a quadrant of sheet iron attached to the rotating gland on the trunnion, and a fixed pointer. The indicator is graduated in degrees, both ways from the vertical.

When the converter is in the correct position for blowing, that is for obtaining the best results, the indicator should show about five to nine degrees back from the vertical, that is the tuyeres should be inclined towards the surface of the metal and the direction of the blast should be very slightly downward upon it. Too great an angle would create too great a disturbance of the bath, which the Tropenas process is designed to obviate. If the angle appears too great or too small, a bull ladle of iron should be taken out or added as the case may be. The height of the iron in the ladle may then be noted and thereafter the cupola tender should have no

difficulty in tapping out the correct amount.

After getting the proper amount of good hot clean iron in the converter, adjusting and noting the angle, the tuyere box covers are put on and fastened in position. Blast is then turned on by giving the customary signal of two short blasts on the whistle or bell communicating with the blower room, and the motor should be speeded to give three pounds on the mercury gauge when the byepass valve is entirely closed. (See chapter one for description of operating station or "pulpit.") Take note for record of the exact time of starting the blow.

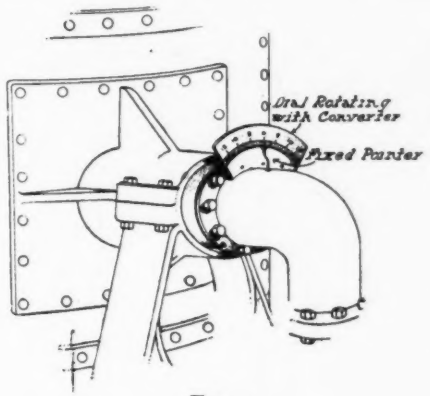


FIG. 1.

At the commencement sparks and smoke should come out of the mouth of the converter but very little flame. The sparks should be copious, large and scintillating, and light yellow in color, the smoke noticeable but not too voluminous, and not too dark brown in color. An experienced operator by noting the appearance of the sparks and smoke can tell during the first minute of the blow whether the silicon content is right, and if he is going to have a hot blow or if it will be necessary to doctor it up as it goes along. The sparks should all go up the chimney in parallel lines, not crossing or shooting out at different angles. In from three to five minutes the character of the sparks should change and become non-scintillating and at the same time a flame should appear at the mouth of the converter. This is the time to open the upper tuyeres slightly, as the carbon is commencing to burn and extra oxygen is needed to complete its combustion and reap the full benefit from the heat generated. At the same time the position of the converter should be advanced from two to three degrees, to compensate for the shrinkage in bulk due to the elimination of the impurities.

During the next four or five minutes the flame increases in brightness and volume until what is known as the "boil" occurs. The flame should be carefully watched and if there is a tendency to throw out any metal the blast pressure should be reduced. In extreme cases it may be reduced to one and a half pounds but this is as low as it is advisable to go. There will always be a certain amount of projection of slag, and this is immaterial unless it interferes with the observation of the flame.

Sloppy blows are indicative of incorrect composition of metal, bad position of converter or too much blast. After maintaining its top position for one or two minutes the flame dies down somewhat, and remains in a quiet condition for some minutes. The upper tuyeres may now be fully opened. It then rises again, becomes particularly bright and clear, and finally dies down for the last time with the evolution of copious brown smoke.

The blow should be turned down a few seconds before the brown smoke appears, as this smoke represents burning iron which means waste of metal and ruination to the remainder. The operator throws over his controller, turning down the vessel into the horizontal position, and a second after signals one whistle to the engineer to stop the blower. At this stage there is in the converter a bath of practically pure iron at a temperature well over 3,000 degrees F. Fig. 2 gives the approximate curves of elimination of the elements in a typical blow. In order to recarburise it to the desired point a weighed final addition of ferro-manganese, ferro-silicon, silicon-speigel or what not is introduced. This may be added melted, in which case a small cupola or crucible furnace may be used. Or it may be thrown in cold in lumps at the mouth of the converter immediately

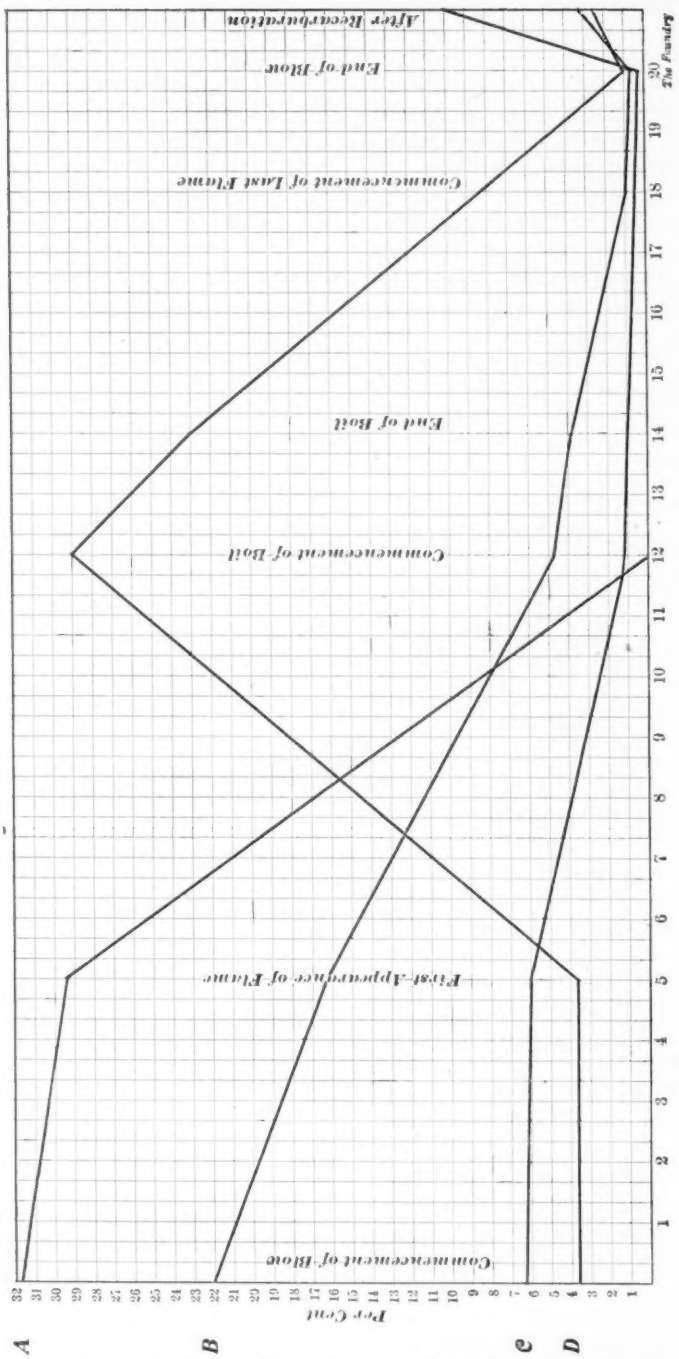


FIG. 2.—CURVES OF ELIMINATION OF ELEMENTS IN A TYPICAL BLOW.

NOTE.—Line A is for graphitic carbon, line B for silicon, line C for manganese and line D for combined carbon.

after turning down the blow, before the slag gets too hard. In this case the lumps must first be dipped in water so that the explosion of the vapor as they strike the hot slag will part it and allow the alloy to go entirely into the bath of metal. This latter way has been found by the writer to be by far the most useful and regular way of adding final additions. A special shaped core for skimming back the slag is fixed in the mouth of the converter and the metal is then ready to be tapped into the ladle. This core is shown in article number one

Fig. 3 of this series, October FOUNDRY.

The above is a description of a perfectly normal blow, which should take place in from fifteen to twenty minutes. Unfortunately all blows are not normal, a great many conditions having to be harmonized to produce that result, some of which occasionally go wrong. Some of the difficulties that arise, with their cause and cure will be touched on briefly. The flame should make its appearance at the mouth of the converter in from three to five minutes. If it comes in less time than that it is a sign that the silicon content of the metal is too low and the probabilities are that the blow will not be as hot as desired, for the silicon is the fuel, and the chief source from which the heat is derived. To offset this, when the flame makes its appearance the converter should be advanced not more than two degrees and about one hundred pounds of ferro-silicon in pig form thrown into the mouth of the converter. This has an astonishing effect and as it melts and gives up its silicon the blow becomes noticeably hotter. If the blow goes on for more than five minutes at the same time the blast pressure remaining the same on the blast gauge, it is a sign that the iron is either too high in silicon or it is too cold. If caused by too high silicon, there may not be very serious results except that the blow will certainly be very sloppy, the loss will be abnormally great, the blow will be longer and the resulting steel may be high in silicon on account of the fact that the carbon burns out before the silicon is entirely eliminated. If the latter is the case there is nothing to do but coax it along and dose it with silicon after the flame makes it appearance.

A frequent trouble due to various causes is the corking of the tuyeres. Its signs are an increase of pressure in the blast gauge without any increase in the speed of the motor, a change in the directions of the sparks, some of which shoot out at all angles instead of all being parallel, and delay in the progress of the reactions. Corking of the tuyeres may cause serious troubles, such as cold blows, and violent reactions. The tuyeres are corked by the formation of nozzles of slag on their extremities which tend to lengthen the tuyeres and may have openings in many directions, dispersing the blast and possibly permitting only a small amount of it to react on the metal. They are caused by cold metal, not setting the position of the vessel correctly, not skimming it clean from slag at the commencement. When this corking is noticed it generally occurs before the flame makes its appearance, and the converter should be turned down, the blast shut off and the projections or nozzles knocked off with an iron bar. The blast is then started and the converter returned to its original position when it will usually proceed all right. It may be necessary to repeat this procedure two or even three times. The result of corked tuyeres is almost invariably a sloppy blow if nothing worse.

In regard to the amount of final addition to be used a good deal could of course be written, also as to the materials to be used. In the first place, let us take the ordinary grades of simple or carbon steel. The analysis to be aimed at varies principally with the use to which the castings are to be put, and secondly to a less extent with the shape and weight of the piece. Speaking from the first standpoint it may be said that the analysis for ordinary machine or engine castings on which a good deal of machining has to be done should be carbon .25 to .30 per cent, silicon .25 to .30 per cent, manganese .60 to .75 per cent, and sulphur and phosphorus as low as possible, under .05 per cent.

For castings which will be subject to a greater amount of wear than ordinary, and for those which require a greater tensile strength such as levers, connecting rods and gears the carbon may be raised to from .35 to .40 per cent, and in cases where the castings are liable to "pull" on account of differences in section, great length, etc., the carbon may be raised to .50 per cent, silicon .30 per cent, and manganese up to 1.10 per cent. These castings last referred to will need to be annealed in all cases.

For the purpose of recarburising to these points the common materials used

are ferro-silicon containing about twelve per cent of silicon, silicon-spiegel containing about ten per cent silicon and twenty per cent manganese, and ferro-manganese containing eighty per cent manganese. The amount to be used can easily be figured by an equation such as was used in section two of this series for calculating cupola charges, but it must be borne in mind that an excess of from twenty to thirty per cent of ferro-manganese must be used to compensate for that which goes to deoxidise the metal, and an excess of about five per cent of the calculated amount of ferro-silicon.

The action of the steel in the ladles is somewhat of an indication of its carbon content to the close observer. The softer and purer the steel the higher is its melting point and therefore in order for it to remain fluid in the ladle and allow it to free itself from gases it needs to be superheated to a higher degree than the harder grades. It is more difficult to "dead melt" soft steel than hard steel and soft castings are more difficult to run and are more liable to blow holes. This is borne out by the fact that gray iron remains fluid in the ladle at a temperature where steel would set.

For making the special or alloy steels such as tungsten steel, chrome steel, manganese steel or nickel steel either the ferro alloys of these elements or the pure products of the electric furnace or aluminothermic process are used, and the amounts vary widely according to the purpose of the castings. The materials produced by the aluminothermic process are very useful on account of their concentration, rendering it necessary to use only the minimum amount to produce the maximum effect, and by the freedom from carbon, etc., making control of the ultimate analysis more simple and certain.

The J. C. Knoeppel Iron Works, East Orange, N. J., has been incorporated to carry on an iron works and foundry, with a capital of $150,000. The incorporators are, H. H. Picking, F. C. Ferguson and A. W. Condit, of East Orange.

ARE FAITHFUL SERVICES PROPERLY RECOGNIZED?

Mr. Editor:—I am not just entirely sure whether it is you or the president that "A Patternmaker" is appealing to to get what is coming to him, but in either case I want to be counted in on it. I don't know him but that is not any reason why we should not be classed together so that you could help us both at once. When you have him put in as general foreman somewhere don't forget me, for I don't want to have to assert myself all alone and maybe hurt some one else's feelings, but I do know that after a fellow has hustled around and cleaned castings for ever so long he knows lots of things and does not like to be kept down just because he works so hard that the dust he raises keeps others from seeing his good qualities.

The time has now come when justice should be done to me and the patternmakers. When they wanted a man to help the molder fuss around and get the cover on his mold did they invite me in? When they wanted a man as assistant in the pattern shop did they come and measure me and see if I would fit? With all the improvement that I have been making in the appearance of the castings along with my fellow sufferers why is it that we have been passed by? Some of us have studied grammar and been through the arithmetic, and can dance and play poker, but what good is it? And right here let me ask, what would castings amount to if they were not properly cleaned? Who would buy them?

"Patternmaker" has shown us the way and so if instead of filling up on sand and cinders and knocking the skin of our hands we put forth our time and attention to getting onto the place where we belong, just a little behind "Patternmaker," we may yet force them to recognize that we should be put into our proper places.

Don't we work for small wages and do the dirtiest and roughest work that there is without a bit of encouragement, unless you think it is such to have a molder come out and say "that there casting there would ha' been all right if one of these lunkheads hadn't chipped the

bosses off and left the gates; it's a wonder that they don't get men with a few brains to do it."

I don't claim that us chippers have the brains and education the patternmakers have but while they could do the planning we would just be the fellows that would like to have the chance to work under them and to hustle around and do the executing. When we were doing that I have an idee that the molders would not look at us in that indifferent or condemning way they do now. It wouldn't be safe, for if they did it wouldn't be pleasant for them.

In your efforts to help the oppressed it would not be necessary to find a whole lot of places, and I'll tell you why. I have not got acquainted with your correspondent, "A Patternmaker," but some patternmakers work here. I went to one of them. He will be an old man pretty soon, and he has never even been put in as boss of the pattern shop, and I could see that he was not being treated right. He listened to me all right, he had got used to listening, and when I got through he said, "How does it come that you are cleaning castings if you were hired as a boss?" I went over it all again just as that piece did and told him about the "asserting" of ourselves as I had heard it time and again. I let him know that a foundry could not run without us, him and me, you know, and that we were "entitled" to things. After all of that line of talk what do you suppose he said? Well, now, you would never guess. It beats all, the narrow view some men take of things. Just listen to this will you. Said he, "Seems to me that I have noticed that the fellow that is hollering around because he is not being pushed ahead as fast as he ought to be is generally the fellow that they can get along without the easiest. He is the first fellow to get out anyhow. If you put up signs on yourself, *This Way for Boss Timber,* you better see to it that they are nice ones or folks might think them intended for scarecrows." Pretty smart chap he was, too, but didn't seem to see how it was jealousy that got the smart fellow out. The bosses don't want to lose their jobs, even if they are not as good as the men who are working for them.

Even my little straw boss that gets two bits a day more than the rest of us is that way, for when I was trying to stir the sparks of ambition (and everybody knows how necessary ambition is to everybody) in the other fellows he came right up and tried to run a bluff on me. Says he, "You get to getting the dirt off from them there castings there, and stay to getting of it off or you git." If I had had another job anywheres I would have got right then and there and left him to get along the best he could. I'd have showed him. It's awful to have to put up with a jealous man like that.

I want to thank you in advance if you do any good for me in the matter, and I am sure I would be an unusual ornament for any job you get for me.

P. S. Since writing this, and going to a lot of hard work doing of it, a fellow shows me a place in THE FOUNDRY where a lot of people say they want bosses of all kinds and told me that me and "A Patternmaker" have only to take our pick. He says that lots of people are just aching for to get bosses, and that it is harder for good men to dodge being bosses than it is for them to get the jobs. He says all I have to do is to go after the job I want and can carry. These people are all strangers to me, and he says they will have to have recommendations before they will be able to start me in. I know the people here will not give me any. They are too jealous for one thing, and then, for all the straw boss's blowing, they don't want to have me get away from them.

Won't you kindly look over them advertisements and pick out a good one and write me a letter of recommendation that will fetch it? I'll do as much for you some day.

Again thanking you if you can do anything for me, and hoping that I may soon be able to sign higher up, I remain, A CASTING CLEANER.

The Speich Stove Repair Co., Milwaukee, Wis., has increased its capital stock from $50,000 to $200,000.

METALS IN FOUNDRY PRACTICE

Devoted to inquiries from Practical Foundrymen on subjects relating to the Melting and Using of Cast Iron, Malleable Iron and Steel.

The following experts answer questions in this department:

W. J. Keep, Cast Iron.

J. B. Nau, Metallurgy of Steel and Steel Castings.

Dr. Richard Moldenke, Malleable Castings.

We have also made arrangements with several others to act as special contributors. All inquiries should be addressed to the Editor of THE FOUNDRY, and they will then be forwarded to those in charge of the different subjects.

CAST IRON NOTES.

BY W. J. KEEP.

HARDENING AND STRENGTHENING CAST IRON.

Question.—I wish to make some hard strong gearing for traction engines. The gearing is from two to three pitch and no very sharp or thin edges. I have not enough of this gearing to make special melts and wish to get the iron from our regular cupola. Can you advise me as to the action of ferro-manganese or spiegeleisen added to iron after it is melted, or is there any hardener used successfully in melted iron? We use ordinary foundry iron for making engine castings. Gearing made from charcoal iron as hard as it can be machined suits our purpose.

Answer.—Fe. Mn. or spiegel broken in small pieces and heated red hot and placed in a hot ladle will probably be melted when the ladle is filled with very hot iron. It is however very difficult to melt. If melted it will harden cast iron, add strength and give excellent wearing surfaces.

By a little practice however, you will be able to make one of your cupola charges exactly suited to any special work. By counting the ladles of iron taken from the cupola you can calculate when the special iron should come down. You can see a change in the iron as it runs from the spout.

If you make the first charge the special mixture you will be certain to get the right iron into the mold.

QUESTIONS FROM A FOREMAN.

The following is from a foundry foreman "not well up in melting and mixing iron but who does not give his name. I would have preferred to answer by letter."

(1) What is the best mixture for castings that are to stand intense heat such as heating boilers, etc.?

(2) What is the correct way to charge a cupola and take up the weight of the day's work?

(3) How can a foreman tell the proper way to charge a cupola of all diameters?

(4) How can you make a good mixture of iron using stove plate scrap with pig, and the percentage of both?

(5) How can you make good mixtures from machinery scrap and pig iron, the percentage of both and which pig is the best for each kind of scrap. Let me know all about the same.

(6) How can I learn to mix all grades of iron and get a good iron? Also the analysis of iron?

(7) Let me know how I can tell the capacity of cupolas. Let me know all about the same.

(8) Let me know what kinds of iron the different foundry pig irons will turn out when melted with machinery scrap or with stove plate scrap and how hard and soft the iron will be, that is, will it be weak or strong?

Answer (1) The shape of patterns has more to do with the strength of heating boilers than the kind of iron used. The iron with least combined carbon will be best say with silicon about 2.75 per cent.

(2) Ask each molder how much iron he will use or else figure from the measure capacity of the molds.

(3) The bed coke should reach about 15 inches above the top of the tuyeres after it is well lighted and just before the iron is charged. The thickness of a charge of iron will be about eight inches and the coke should weigh about 1-10 as much as the iron for each charge.

(4 and 5) The pig iron that con-

tains most silicon will carry most scrap. Stove plate scrap contains more sulphur and more silicon than machinery scrap. Stove plate scrap will give a close grain to castings. Machinery scrap will make castings stronger. The proportions will depend upon the character of the castings.

(6) You can have a chemist analyze your iron but I would simply ask the broker that you purchase your iron of what silicon the iron is expected to contain. If your castings are not soft enough increase the irons with highest silicon. If the grain is too coarse increase machinery scrap. You would not know how to use an analysis if you had it.

(7) Capacity depends upon blast size of iron charged and care in charging.

(8) The castings will be stronger and have closer grain than the pig iron. The hardness will depend on the proportion of scrap and upon the percentage of silicon in the casting.

IRON MOLDS.

Question.—I am having trouble making iron bedsteads. The way that I try to make them is by having a lot of iron molds and then fasten them in a frame made for the purpose, lay the pipe and iron in the molds and then fasten the cope part on and pour them, but the melted iron does not seem to want to enter the molds freely, that is, the iron coldshuts and leaves the molds about half poured.

Answer.—Have your mold finished smooth. Mix plumbago with oil and coat the mold with it. You cannot use scrap but must use pig iron quite high in silicon (3.00 per cent) and phosphorus (1.00 per cent) and melt with coke with sulphur less than 1.00 per cent. Melt the iron very hot and you will have no trouble. Change the molds as rapidly as possible so as to have them remain hot.

NEW CONSTRUCTIONS.

The Standard Foundry & Mfg. Co., De Kalb, Ill., expects to begin operating its new plant Jan. 1, with a capacity of 250 tons per month, for the production of gray iron castings and machine specialties. The main building is 66 x 200 feet, with an L 40 feet square. S. M. Hunt and A. N. Wheeler are the promoters.

The W. H. Howell Co., Geneva, Ill., is erecting an addition to its foundry.

The Vulcan Iron Works, Chicago, has purchased additional property in that city, on which, it is reported, it will erect a new plant.

The Chicago Malleable Castings Co., West Pullman, Chicago, has contracted for an additional foundry building, 75 x 265 feet, to be known as foundry No. 5. This will be ready for occupancy Dec. 15 and the equipment has already been purchased.

The Western Foundry Co., Chicago, Ill., will erect a one-story brick foundry, at a cost of $15,000, at 3601-53 Spaulding avenue.

Plans have been prepared for a large addition to the foundry of Love Bros., Inc., Aurora, Ill.

The Superior Iron Works, Superior, Wis., is adding a two-story brick building to its plant to care for increased business.

The Valley Construction Co., Milwaukee, has let contracts for a foundry building, 70 x 160 feet, pattern shop, power house, etc.

C. W. George Everhart, president of the Challoner Foundry Co., Oshkosh, Wis., is planning the erection of a steel casting plant at that city, primarily to supply the needs of the Challoner Co. The main foundry building will be 80 x 140 feet. Construction will probably not begin before spring.

The C. A. Lawton Co., De Pere, Wis., is planning to make an addition to its foundry.

The Standard Foundry Co., Detroit, will erect an extensive plant in that city, and greatly increase its force.

The new foundry of the W. Smith Grubber Co., La Crescent, Minn., is nearing completion.

THE FOUNDRY

PUBLISHED MONTHLY BY

THE PENTON PUBLISHING CO.

CLEVELAND

BOSTON DULUTH CHICAGO

CINCINNATI NEW YORK

PHILADELPHIA

PITTSBURG

The subscription price of THE FOUNDRY is $1.00 a year to points in the United States, Canada and Mexico. To Great Britain: Eight Shillings. Single copies 15 cents each.

Change of advertising copy must reach this office on the 10th inst. preceding date of publication.

The Cleveland News Company will supply the trade with THE FOUNDRY through the regular channels of the American News Co.

European Agents: The International News Company, Breams Building, Chancery Lane, London, E. C., England.

Practical articles pertaining to the trade in all its branches are solicited and will be paid for.

When sending articles be sure to place your name and address on the article and on the drawings.

Entered as second-class matter at the Post-Office at Cleveland, Ohio.

PRINTED IN AN OPEN SHOP.

CONTENTS.

A New Line of Molding Machine Practice. 223
The Reduction of Foundry Costs..... 239
The Chemist's Lament..... 243
Brass Foundry Department of the Westinghouse Electric & Mfg. Co..... 244
Brass Foundry Notes..... 247
Trade Publications 251
Open-Hearth Steel Castings..... 252
Power Attachment for a Core Machine.... 258
A Bevel Gear Pattern..... 260
Multiple Core Boxes..... 265
The Making of a Crooked Elbow..... 269
White Metal Patterns..... 271
Converter Steel Casting Practice..... 272
Are Faithful Services Properly Recognized? 276
Cast Iron Notes..... 278
Trade Outlook 280
Associations and Societies..... 282
Among the Foundry Supply Fraternity... 289
Trade Notes 298
Personals 299
Deaths 300
New Construction 301

TRADE OUTLOOK.

The trade outlook is peculiar in a number of respects. Most foundries have a very large volume of work on hand at present, and in fact many of them are melting much more iron than they had expected when they closed their present contracts for pig iron, so that the fact that some interests supposed they had covered their requirements for a given period may not hold true, as the excessive amount melted will require purchases earlier than would otherwise have been the case. This condition will tend to aggravate the pig iron situation. At present the pig iron market for future deliveries seems firm but spot iron brings any price that the purchaser is willing to pay for it. There are many problems which complicate the situation as winter approaches. First, there is the car shortage which has been staring us in the face every winter for several years, and the very large production of new cars this past year is scarcely sufficient to take care of the increased demand for rolling stock. As the bad winter weather comes on and the roads become congested it is probable that many industries will be seriously hampered. Some manufacturers have already experienced considerable difficulty in securing a sufficient amount of coal to operate their plants.

The labor situation in many districts is also a serious problem, and an interesting experiment has recently been started by deflecting a portion of the immigrant influx from New York to Charleston, as the southern field is especially in need of help of all kinds.

Both English and Scotch pig iron is being imported quite freely and it is probable that at least 100,000 tons will have been received in this country before the first of the year. The iron thus far received is practically all for foundry purposes, though the steel makers are beginning to look abroad for iron to help out some contracts. There is a very great difference of opinion as to whether it is advisable to purchase iron for a third quarter or second half delivery for 1907, but a number of interests are closing contracts to cover

their requirements for the periods mentioned.

Northern No. 2 foundry is quoted at $24.50 to $25 valley furnace for the balance of the year and the month of January. For second quarter deliveries it is quoted at $21 valley furnace. No. 2 southern foundry is quoted at $23 Birmingham for spot delivery, with very little available, and for second quarter, southern furnaces are quoting $18.50 to $19 Birmingham. It will be noticed that these prices are very much above those which were quoted some time ago and some consumers feel that there will be a slump in the market so that third quarter or second half deliveries can be obtained much cheaper. In the first place it must be borne in mind that the iron ore contracts for 1907 have practically all been closed on a basis very much higher than those for 1906. The prices paid for ore are such that it will result in an increase in the cost of pig iron of from $1.25 to $1.75 per ton, due to ore alone. Labor conditions, increased prices of coke, and other factors will add to this increase, so that it is hardly likely that the price can go as low as it was formerly, for it would necessitate the furnaces working at a decided loss and this is never continued for any length of time.

If conditions can be held stable it is probable that the present wave of prosperity will continue for some time, but any grasping tendency on the part of employers or employes might precipitate a crash in a comparatively short time. The large manufacturing interests seem to be willing to make a moderate profit and not attempt to force prices abnormally high and if this tendency continues it is hoped that the balance will be maintained for a long time. In most industries the labor cost has increased greatly during the past two years, and if excessive demands are not made it is probable that the market will not be upset from this cause.

The conditions under which the American people work are very well illustrated by the present situation. When this country was in its infancy and depending largely upon support from abroad to supply its demands in the way of manufactured products, etc., it was natural that its people should turn to the fisheries, whaling, and other maritime pursuits. As the natural resources of the country came to be developed they were so great that the industries which grew out of them gave employment to an ever increasing number of citizens. The demand for labor created higher and higher prices and attracted not only extensive foreign immigration but attracted many men from the sea-faring life to the life in the factories and manufacturing plants, and the time came when the eastern states no longer produced the food stuffs which they required, but became the workshops of the country, while the prairie states produced the food stuffs. This development has been and is still going on, so that in order to avail ourselves of the resources of our country to the greatest possible extent we have to use all of our energies in the lines of manufacturing and in the development of the various projects within the country.

It is only in times of rest in this development that the majority of the manufacturers think of exporting to foreign countries. The time has come, however, in many lines, when a considerable portion of our output finds its way abroad. Our workmen are paid a higher rate of wages than those of any other country and can with their wages secure more of the comforts of life than those of any other country, but in prosperous times like the present there is a tendency on both sides to overdo the matter and try to get ahead too fast. This always results in a collapse and period of stagnation which we call a panic. In the foundry industry the prices of raw material and labor have gone up more rapidly than the price of finished castings. This is always the case in an advance of this kind and the only way that the foundryman can meet these conditions is by arranging for an increased output by the use of better rigging or more modern machinery.

ASSOCIATIONS AND SOCIETIES.

New England Foundrymen's Association.

Fred F. Stockwell, Secretary, care of the Bar bour-Stockwell Co., Cambridgeport, Mass.

The regular monthly meeting of the New England Foundrymen's Association was held at the Exchange Club, Boston, on Wednesday, Nov. 14. Dinner was served at six o'clock, after which the routine business of the evening was disposed of in the usual manner, President Walter B. Snow in the chair.

A report from the committee appointed to prepare resolutions anent the the death of Mr. Edgar B. Pierce, was received and the resolutions adopted.

Announcement was made that the executive committee had made arrangements for the next meeting, which will be held in Boston on Dec. 12, as follows. The afternoon session will be addressed by Mr. Thos. D. West, of Sharpsville, Pa., on the subject "Cause, Cost and Remedy for Carelessness." At the evening session Mr. Herbert E. Field, of Pittsburg, Pa., will speak on "Foundry Education."

The chairman then introduced as the speaker of the evening, Dr. Richard Moldenke, secretary, American Foundrymen's Association, Watchung, N. J., who gave a talk on malleable cast iron. At the conclusion of the remarks a unanimous vote of thanks was extended to Dr. Moldenke.

There being no further business the meeting adjourned at 9:15 p. m.

Philadelphia Foundrymen's Association.

Howard Evans, Secretary, care J. W. Paxson Co.

The monthly meeting of the Philadelphia Foundrymen's Association, which was held at the Manufacturers' Club on the evening of Nov. 7, was largely taken up with the annual survey by A. E. Outerbridge, the well-known metallurgist, of a year's progress in the steel and iron trades, with some references also to copper, aluminum and other important metals. Dr. B. B. Brown, chairman of the entertainment committee appointed to arrange for the proper reception of the annual convention of the American Foundrymen's Association next June, reported that a meeting had been held, but nothing decided upon as to the program for entertaining the delegates. A brief discussion as to what could be done with burned foundry sand brought out a general agreement that it was very excellent material for making concrete floors, and for nothing else.

Pittsburg Foundrymen's Association.

F. H. Zimmers, Secretary, care Union Foundry and Machine Co., West Carson Street.

The November meeting of the Pittsburg Foundrymen's Association was held on Monday evening of this week at Engineers' hall, Fulton building, Pittsburg. Dr. Bradley Stoughten, of Columbia university, New York, delivered an interesting address on "Foundry Mixtures," going into the effects of various impurities, phosphorus, sulphur, silicon and carbon, in pig iron, also discussing shrinkage, porosity, softness, workability and strength, and the effects of sulphur and manganese in the mixtures, and showing the results of checking or cracking in castings. The lecture was illustrated with about 30 lantern slides. A vote of thanks was tendered Dr. Stoughten by the association.

BRASS FOUNDRY ASSOCIATION.

For a number of years there has been a movement on foot to form a brass foundry section in connection with the American Foundrymen's Association. At the Cleveland convention the matter was discussed, and it was decided it was better to form a separate association, which was to be affiliated with and meet at the same time that the A. F. A. meets, but which would have an independent organization. A committee was appointed to canvass those interested in the brass foundry industry and see what could be done in this connection. Mr. Chas. J. Caley, of Russell & Irwin Co., New Britain, Conn., was appointed chairman of the committee, and he, together

with Dr. Moldenke, secretary of the A. F. A., have sent letters to between 5,000 and 6,000 firms connected with the brass or brass working industry and it is hoped that this will result in the formation of a large and strong brass foundry association. We are informed that several hundred favorable replies have been received.

The first meeting of the association at the time of the A. F. A. convention in Philadelphia, May 20 to 24 next, will be not only a large but a very successful and enthusiastic gathering. It is certain that there is a very broad field for work along this line, and that by coming together, reading papers, and discussing topics, those interested in this important branch of foundry practice and also in the allied lines of plating and finishing will derive a great benefit. This movement certainly should be a success, especially as it is evident that the next convention of the A. F. A. is to be by far the largest ever held in the history of the organization.

Philadelphia Foundry Foremen.

W. P. Cunningham, Secretary, care American Bridge Co., Pencoyd, Pa.

The Associated Foundry Foremen of Philadelphia and vicinity, held their 20th meeting on November 12th, and it proved to be one of the most interesting and instructive meetings thus far held. Four new members were added to the roll, and the officers for the ensuing year were elected. A committee was appointed to assist in entertaining delegates to the American Foundrymen's Association and Associated Foundry Foremen conventions to be held in Philadelphia May 20th to 24th next. A paper on the manufacture of light gray iron and stove castings was read and discussed. There was also a discussion on various foundry subjects, including the relative merits of fluor spar and limestone, the use of match boards, etc. The officers elected are as follows: President, W. A. Parrine, superintendent Abram Cox Stove Co., Philadelphia; vice president, Ed. H. McCoy, Stanley G. Flagg Co., Philadelphia; treasurer, Geo. M. Benkert, Fairmount Foundry Co., Philadelphia; secretary, W. P. Cunningham, American Bridge Co., Pencoyd, Pa.; trustee, Adam Pugh, T. A. Sheppard & Co., Philadelphia.

The committee appointed to assist in the entertainment of the delegates to the convention to be held in Philadelphia next year consists of: W. O. Steele, of the Bateman Manufacturing Co., Grenloch, N. J., chairman; W. H. Creamer, Wm. Adams Co., Philadelphia; Jno. Alexander Harrison, Harrison Safety Boiler Co.; Geo. M. Benkert, Fairmount Foundry Co.; Wm. E. McCleary, Crompton Knowles Co.; Geo. Moyer, Enterprise Mfg. Co., Jas. B. Strain, Robt. Whetherhill Co., Chester, Pa.; Ed. T. Spurr, Enterprise Mfg. Co.; Thos. G. Smith, Midvale Steel Co.; W. A. Parrine, A. Cox Stove Co.; A. Pugh, T. A. Sheppard Co.; C. R. Brown, E. E. Brown Co.; Chas. C. Cook, Schann & Uhlinger Co.

New York Foundry Foremen's Association.

W. S. McQuillin, Secretary, South Norwalk, Conn.

The seventeenth meeting of the New York branch of the Associated Foundry Foremen was held at the Grand Union hotel, in New York City, on Saturday evening, Nov. 17, with a good attendance. After the routine business the subject of "Flat Plates" was taken up for discussion and it proved to be of exceptional interest. The discussion covered many phases of the subject, including methods for overcoming the persistent tendency of these plates to warp or come out crooked on account of unequal contraction during cooling. The members joining in the discussion were mainly representatives of the structural and stove plate branches of the business. The facts brought out seemed to favor the conclusion that to keep a plate true it was necessary to keep the edges hot and also to reduce the strains to a minimum. This is particularly true in the

case of stove plate castings or in castings which are very thin. The next meeting of the association will be held at the Grand Union hotel on Dec. 22, and the subject for discussion will be cupola practice and melting ratios. All foundrymen in this district are cordially invited to be present.

Cleveland Club of Associated Patternmaker Foremen.

H. J. McCaslin, care Wellman-Seaver-Morgan Co., Secretary.

The second meeting of the fall and winter series of the club was held on Monday evening, Oct. 29, and proved to be one of the most interesting, as well as one of the best attended meetings thus far held. Three very interesting papers were read and discussed. The president, Mr. Jabez Nall, read a paper describing a method for making the pattern core boxes and core plates for a light cast iron shell pattern for a heater pipe. This brought out considerable discussion, as it illustrated many very good points. The next paper was read by Mr. Newart on loam and sweep work. This was much appreciated and discussed. Mr. Newart understands this class of work thoroughly and the paper included the arrangement of sweeps, molds, etc., as applied to the production of heavy circular pieces. A talk was also given by Secretary H. J. McCaslin on molding machine practice as applied to green sand molds for trucking bolsters. All of the papers were well illustrated by large drawings showing the construction of the patterns, arrangement of the sweeps, core boxes, molds, etc.

The meeting all the way through was more or less of an informal nature and, in fact, was practically a smoker. It has been found that these informal meetings, interspersed with good cigars and an occasional story are much better than a more formal meeting, as it tends to give a freedom in the discussion of papers. After the papers, the members listened to a few well told stories, checked up some old patterns and the association adjourned to meet again on Monday evening, Nov. 26.

Cleveland Foundry Foremen.

H. M. Lane, 610 Schofield Bldg., Secretary.

The regular monthly meeting of the Cleveland Club of Associated Foremen was held at the American house, Saturday evening, Nov. 10. There was an unusually large attendance, and it was one of the best meetings which the club has ever held.

Melting Practice.

After the transaction of the regular business and the reports of the committees, Mr. L. G. Blunt, superintendent of the Ferro Machine Co., of Cleveland, gave a talk on melting. Mr. Blunt's remarks were not confined to cupola practice, but covered both cupola and air furnace practice, though naturally a majority of those present were particularly interested in cupola problems. The following is a brief synopsis of Mr. Blunt's remarks:

The most of the trouble experienced in the foundry is caused by poor melting, whether it be in the cupola or air furnace. The air furnace is not much used outside of the foundries manufacturing rolls. These specialty foundries have experimented until they have found the best mixture for their class of work, and the melting is in the hands of old reliable employes who have been with them for a long time, so that their experience does not form a basis for the ordinary jobbing foundry to work by.

Concerning the foundry chemist, Mr. Blunt's remarks were exceedingly interesting. The majority of college men do not like manual work, or anything that is hard work, or dirty. They are willing to do the nice work in the laboratory, but will not assist in charging a furnace and possibly wheeling the iron, nor will they take hold of a molding machine, master its complications and set the pace for other men to follow. Such a chemist is of little use, because no mere analysis of a piece of iron will tell all about it. The chemist can be given two pieces of iron the analysis for

which will vary but little, and yet every foundryman knows that one is bad iron and the other is good. One is full of blow-holes and cracks, and the other is sound. The chemist can give no reason for it from any ordinary determination. The secret of the bad iron in this case is burnt iron; hence the chemist must be able to judge the foundry conditions. He must be a man who is ready to turn his hand to anything, must watch the charging of the cupola to see whether all big scrap is put on one charge and all small scrap on another; also whether good or bad coke is used, and if bad coke, see that more of it is put on than when the good coke is used. There is no use in weighing coke to the pound, as it is much better to simply measure it. The chemist should not only watch the charging, but the tapping of the iron and the pouring.

In most of the larger shops every man is responsible for some one thing, with a general superintendent to shake them all up. The chemist is in a position that fits in between several other men, and if he works in harmony, he can do a very great deal of good, but he cannot do it all.

When a large mold is being poured, he should be up on the mold to see that the gate or pouring basin is kept up, and he should also be familiar with the manner in which the casting is gated.

The kind of man that is wanted is a man with springs in his heels who will apply his knowledge of physics and chemistry, and other subjects in every way that he can. He should watch the iron in the ladle and see how it holds its heat, whether it boils or not, should be there when the casting is shaken out, see the gates broken off and observe the fracture of the iron. It is better that he have a college education, as this will save a large amount of time in his training, for at the college there is someone to teach him and laboratories in which to experiment, but he must not get the idea that he knows it all.

The chemist will soon learn that when the iron acts in a certain way, he will have bad castings. He may say that oxygen is the cause, but it would be exceedingly difficult to prove it. The important point is to find out how to stop it, and if the chemist can do this, he is a valuable man to have about the place. Some foundries get a young man just out of college and pay him $50.00 or $75.00 a month to stay in the laboratory and make analyses, and after having a lot of trouble with the chemist, they finally call the whole job off and fire him. No wonder. Such an arrangement cannot result in anything but bad practice. The chemist should be given a chance, and a man who is not worth from $150.00 to $200.00 per month, after he has mastered the foundry practice, is not worth having around. In many cases the foundry foreman or superintendent does not give the chemist a chance to really become valuable. When he first comes into the work he usually knows little or nothing about foundry practice, as he comes straight from college. He should not be kept in the laboratory, but should be brought out on the floor and told about the gating of the molds, and all the other details of molding. If he is an active, earnest fellow, he will some day make a valuable man, and will take hold of the work himself, and want to learn how to do it with his own hands. He should analyze the pig iron and coke when they are received to see that they are within the proper limits, and then should try to learn all that he can about molding. Later, when he has mastered much of the foundry side of the proposition, it is well to throw responsibility on him and see whether he is resourceful or not. Few men with a college education care to work in the foundry, but for those who do, there is a wide and useful field. If the college man does not show a tendency to pitch in and master the problems, it is well to get rid of him as quickly as possible.

To turn to the melting problem, all are familiar with the cupola, and prac-

tically all foundrymen are familiar with the fact that iron, to meet the highest specifications, has to be made in the air furnace.

When the foundryman decides to install a cupola the manufacturer comes along and says our 72-inch cupola will melt twelve to fourteen tons per hour at a ratio of 1 to 10, or 1 to 12, with a given blast pressure; but this manufacturer does not say how many bad castings the cupola will make when running as already stated. He also does not say how much iron will go up the flue.

Many tons of carbon enter the cupola in the form of coke, but only a few pounds are dropped at the end of the heat, the carbon having been burned up to melt the iron. Under certain circumstances the iron will burn almost as well as the coke. All that is necessary is to hold it at the proper level and drive plenty of hot air against it.

If an attempt is made to melt at a ratio of ten to one or higher, lots of castings will crack, and sulphur will be blamed for it. Sulphur is not to blame in such a case in any way, but burnt iron is the guilty party. A foundry operating in this manner may save $4,000.00 a year in coke, and lose $20,000.00 to $30,000.00 a year in bad castings. Whatever you do, do not try to save coke. Also, do not let any of the flux agents come around and tell you that they can raise your melting ratio by using so-called thermit. True, thermit is a mixture of iron oxide and aluminum, the latter being a metal. Aluminum has such an affinity for oxygen that if a reaction is started by heating the thermit at one point, the aluminum will be burned up, and in so doing will derive its oxygen from the oxide of iron, thus leaving pure iron, but alumina is the oxide of aluminum, and no further heat can be gotten out of it any more than you can get heat out of ashes.

For ordinary castings a melting ratio of one to six can be used, while for heavy work with good coke a melting ratio of one to seven may be safely used. The blast pressure depends entirely on the height of the charging door above the tuyeres, as it is the height of the charge which the blast has to go through which gives it resistance, and it is the resistance that makes the pressure necessary. This is very plainly shown by the fact that when the fan is blowing into the empty cupola either at the beginning or end of the heat, there is practically no pressure showing on the blast gauge. It is not necessary to lose five or six per cent of the iron in melting, as not over one per cent of the actual metal may be burned up.

The iron should be tapped from the furnace blazing, smoking hot. If this is not the case the iron may look nice at first, but become dead by the time the ladle has been hoisted and carried to the end of the shop. It is only by having the iron super-heated that its latent heat will be given out as the iron cools, and that you can be assured of having it hot enough to pour any piece.

One trouble with the cupola metal is that the slag does not come to the surface of the metal freely, hence the formation of slag should be avoided as far as possible.

Very hot iron does not oxidize as freely as iron that is cooler, and it is the oxidation of the silicon and other elements contained in the iron that forms the slag. This can be very easily proven by pouring a bull ladle of very hot iron from one ladle to another, having skimmed the iron thoroughly before the transfer. After it is all in the second ladle you will see a very small amount of slag come to the surface. If the iron is then allowed to cool until it begins to act dead and once more poured from one ladle to another, it will be found that after pouring the ladle is practically covered with slag.

Now the same thing happens when the mold is filled. Hot iron will go into the mold and fill the casting with good, clean, sound iron without the formation of slag. If the iron is some-

what dull, slag will result, will be formed in the mold and trapped in the iron, thus possibly ruining the casting. No form of skimming gates will avoid or hold back such slag. The molds should be made with proper sand and facings so that they will stand the hot iron, and then the iron poured just as hot as it can be gotten into the molds. This is especially true in the pouring of cylinders.

When pouring a large cylinder from the bottom, Mr. Blunt spoke of having looked down through the riser and watched the metal as it came up through the mold. Slag seemed to form on the surface of the metal, crack in the center, stick to the sides, and the clean metal rise from the center, this being repeated over and over as the metal came up. This action would account for the scabs often found in some classes of castings. It was stated, however, that if the mold be poured fast and very hot, that the surface would not be covered with slag and the cracking and sticking to the surface of the slag already referred to, would not take place.

In discussing the paper, Mr. MacKenzie, of the American Ship Building Co., stated that its employes poured all of their cylinders on end with pop gates, and that he did not remember ever having seen one thrown out on account of a scab in the bore.

Mr. Blunt said that the iron must be hot, but not wild. It is a bad mistake to see how fast the heat in the cupola can be brought down, and it does not pay under any circumstances to try to save fuel at the expense of good metal.

In the air furnace it is also a mistake to try to save fuel. Air furnace practice takes a more skillful melter than is required in cupola practice. The furnace man must watch the flame through the puddling holes and govern his fire accordingly.

One great advantage of an air furnace is that it is possible to take samples of the iron during the progress of the heat. A good, swift chemist can make determinations for silicon and sulphur in ten minutes. The skillful melter, however, who is familiar with his furnace conditions and stock, can judge the analysis within ten points of carbon from the fracture of the test pieces cast.

If the iron in the air furnace is not coming down just as it is required, the furnace man can doctor it either by changing the treatment or making additions so that when finally poured the metal is suitable for the work.

In air furnace practice the charge is melted and it immediately settles under the slag, where it is protected during the balance of the heat.

In cupola practice the iron has to settle through the slag, and each successive tapping results in the rise and fall of the iron and slag levels, and the mixing of the two.

Air furnace iron is always stronger than cupola metal. The ordinary standard cupola iron which would give 22,000 pounds breaking strength when melted in the cupola, would, if melted in the air furnace, show a strength of about 32,000 pounds, and regular charcoal iron melted in the cupola which would show about 30,000 pounds per square inch, if treated in the air furnace would show about 42,000 pounds per square inch. This greater strength is due, to a large extent, to the freedom of the air furnace iron from slag, and also is due to its lower total carbon. Graphite crystals separate the grains of iron and thus reduce its strength, and the coarser and larger these crystals, the greater the reduction. This is one reason why cupola metal is so much weaker than air furnace metal.

The paper was followed by an interesting informal discussion in which most of the members present took part, exchanging experiences and talking over various phases of cupola practice.

After a hearty vote of thanks to Mr. Blunt for his paper, the meeting adjourned to meet Dec. 8.

Foundry Supply Association.

H. M. Lane, 610 Schofield Bldg., Cleveland, Ohio, Secretary.

During the past month the secretary of the Foundry Supply Association has been sending out letters to foundry supply men throughout the country telling of the organization of the association and soliciting membership. A large number of firms have sent in their applications for membership, and also applications for space in the exhibit which is to be held in Philadelphia. It is evident that this is to be not only a large, but a very instructive exhibit, and elaborate plans are in preparation on the part of many supply men, and especially by equipment dealers.

The fact that the Brass Foundrymen's Association will undoubtedly be in a flourishing condition and meet with the American Foundrymen's Association adds to the interest which will be taken in the convention, and also in the exhibit, as it will be the first time that the brass foundry interests have been largely represented at the American Foundrymen's Association convention, and also will be the first time that those manufacturing supplies and equipment especially adapted for this line have had an opportunity to place an exhibit before those who are specially interested in the subject.

It must be remembered that when a man thinks enough of the association meeting and exhibit to pay his way to Philadelphia, or if his firm thinks enough of the value of it to pay his way there, that man is certainly ready to consider any equipment which can be used in the special line of foundry work in which he is engaged.

The writer happened to enter a foundry a short time ago and noticed quite a large group of molding machines of a certain type which had recently been installed. The superintendent of the foundry pointed to them and said: "There is one of the fruits of the American Foundrymen's Association convention, as it was the first time I had ever had an opportunity to compare molding machines and decide what was especially suited for the class of work which we are making." In like manner, many other exhibitors have found that the actual demonstration or showing of their appliances has resulted in new customers in unexpected places.

AMERICAN FOUNDRYMEN'S ASSOCIATION.

Dr. Richard Moldenke, Secretary, Watchung, N. J.

BRITISH FOUNDRYMEN'S ASSOCIATION.

F. W. Finch, Kingston House, Lonsdown Rd., Gloucester, Eng., Secretary.

PACIFIC COAST FOUNDRYMEN'S ASSOCIATION.

J. D. Morris, Secretary and Treasurer, Seattle, Washington.

BUFFALO FOUNDRYMEN'S ASSOCIATION.

John E. Gorss, Secretary, 23 Builders' Exchange.

THE ASSOCIATED FOUNDRY FOREMEN.

Frank C. Everitt, care the J. L. Mott Iron Works, Trenton, N. J., Secretary.

MILWAUKEE FOUNDRY FOREMEN.

Julius M. Germanson, 931 Allis Street, Secretary.

CINCINNATI FOUNDRY FOREMEN.

E. W. Cadwell, Secretary, care S. C. Tatum Co.

CHICAGO FOUNDRY FOREMEN.

Mr. Thompson, Link Belt Co., District Vice Pres.

NEW YORK FOUNDRY FOREMEN'S ASSOCIATION.

C. H. Thomas, 14 Elizabeth St., So. Norwalk, Conn., District Vice President.

ERIE FOUNDRY FOREMEN.

W. F. Grunau, Dist. Vice Pres., care Erie City Iron Works.

INDIANAPOLIS FOUNDRY FOREMEN.

W. S. Keller, of Hetherington & Berner Co. District Vice President.

HAMILTON, ONT., FOUNDRY FOREMEN'S ASSOCIATION.

A. Chase, care Sawyer & Massey Co., Secretary and Treasurer.

The Michigan Stove Co., Detroit, is soon to begin work on a $125,000 addition to its plant. The main new building will be seven stories high, 64 x 150 feet, and another structure 75 x 150 feet, three stories in height, will be added.

Among the Foundry Supply Fraternity.

A NEW INSTALLATION OF CORE OVENS.

The J. D. Smith Foundry Supply Co., of Cleveland, O., has recently built for the new foundry of Landers, Frary & Clarke, of New Britain, Conn., a set of core ovens which are of special interest for several reasons. The oven will handle small cores weighing from ½ ounce to six pounds, and many of the cores are of such shape that any vibration would ruin them. For this reason it was necessary to design an oven which would do away with all vibration. The oven is underfired and the draft regulated by suitable dampers. Owing to the construction of the foundry it was necessary to use but one fire-box, and the limitation as to the height of the top drawer introduced additional complications in the design.

There is a basement under the foundry which is used for storage and other purposes. The foundry floor is made of six inches of reinforced concrete which is supported by 18-inch I-beams. It was found necessary to suspend the fire-box and fire-pit. The main floor running under the oven had to be placed above the I-beams and at the same time the I-beams had to be insulated from the heat to prevent damage to the building. A good idea of the general construction of the oven can be obtained by consulting Fig. 1, from which it will be seen that there is a battery of eight single ovens,

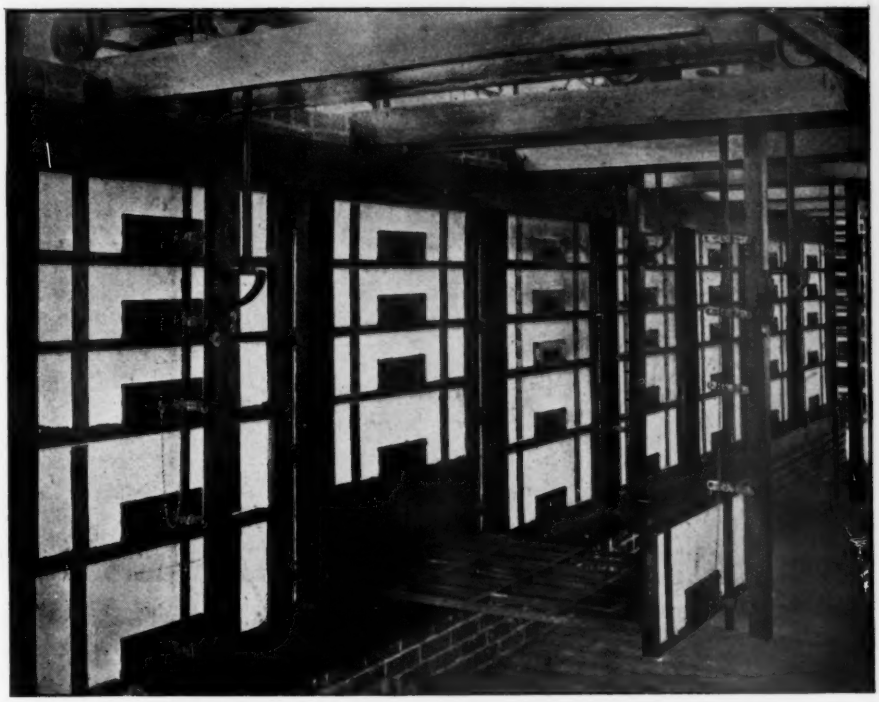


FIG. 1.—FRONT OF OVENS SHOWING DETAILS OF DRAWER.

the total length being 34 feet four inches. Each oven contains four rolling, rectangular drawers. The bottom drawer is 10 inches high, the next one eight inches and the three top drawers five inches in the clear. Each drawer is 34 inches wide by 45 inches long and consists of a cast iron grating with vertical ends which serve as doors when the drawer is either in or out. There are also two tail pieces bolted to the back of the door which may be attached to any one of the oven openings and on the other the handle for lifting the drawer. In Fig. 2 trolleys are shown very plainly in several positions while in Fig. 1 the lifting handles of the first two trolleys are plainly shown. The first one is arranged to support the third drawer from the top. The front of the drawer to be lifted is attached to the lifting rod by a loose pin as shown. The handle is then pulled down until the

FIG. 2.—FRONT OF OVEN SHOWING DETARTS OF TROLLEY.

rest on the axle of the two supporting wheels. When closed the front end of the door is supported on the oven frame. The front of each door is protected by a piece of one-half inch asbestos mill-board for heat insulation.

The drawers are opened singly and the operation necessary to accomplish this is made clear by consulting Figs. 1 and 2. There is a trolley which runs on channels in front of each set of drawers and suspended from this trolley is a vertical rod on one side of which there is a bar which retaining hook engages it. In Fig. 1 the second trolley is supporting the bottom drawer, which has been withdrawn, while the third trolley is detached from the drawers and drawn back out of the way. When the drawer is pulled out it exposes the grating upon which the core plates are ordinarily placed, as shown in Fig. 1. The levers carried by the trolley are so arranged that a pull of 10 pounds on the handle will lift 200 pounds on the trolley. The entire 40 drawers have 450 square feet of baking surface

actually available for baking cores.

The fire-box and firing pit are contained in a reinforced concrete pit 8 feet wide, 12 feet long and 5 feet 7 inches deep, which is suspended from the foundry floor as shown in Fig. 3. The oven was guaranteed to work under a fuel consumption of 700 pounds of hard coal every 10 hours, and in the test ran eleven days on 7,400 pounds, or 673 pounds per day.

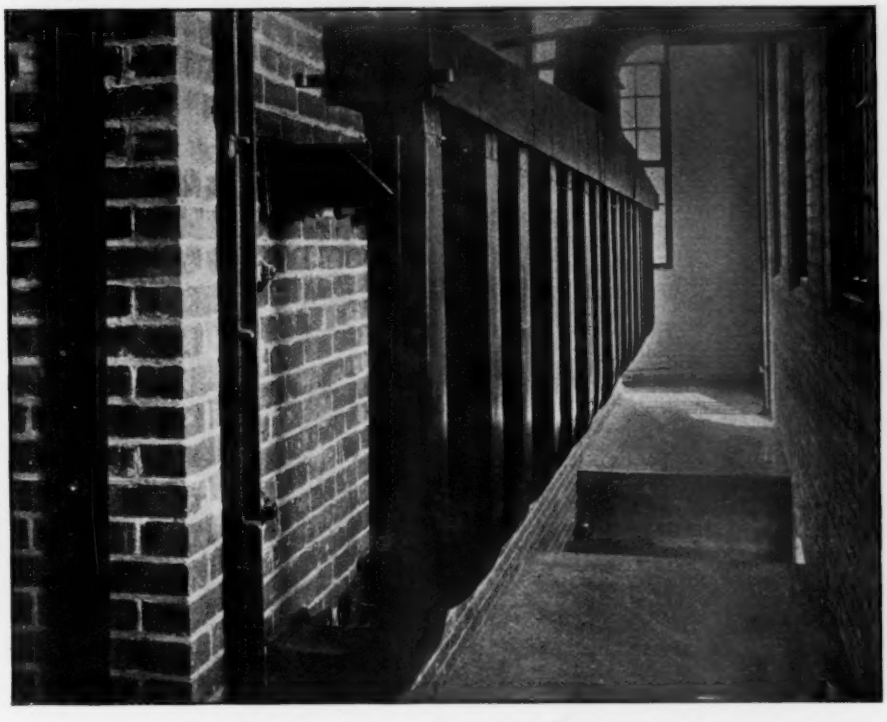


FIG. 3.—REAR OF OVENS SHOWING FLUES.

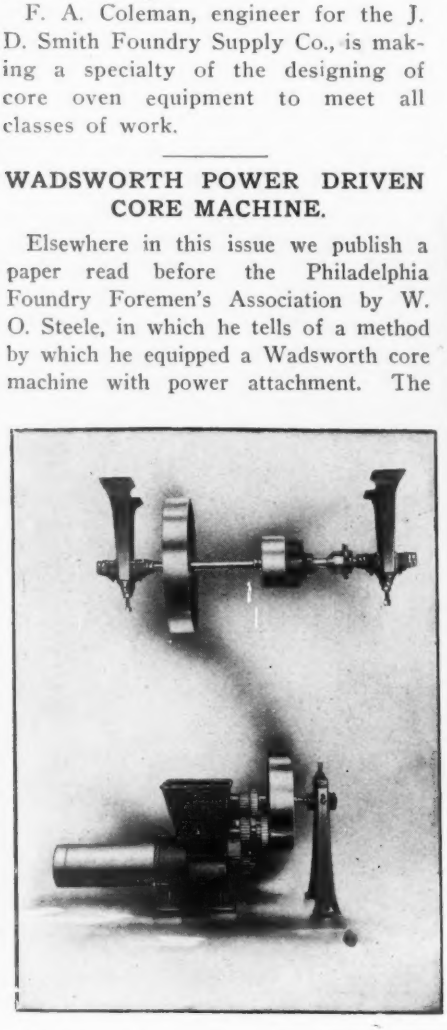
The passages for the heat are so arranged that each oven receives heat through three small openings in the bottom at the front. After passing through the oven the hot gases may be taken out from the top of the bottom by simply connecting the flues, which are shown in Fig. 3, each of the openings being controlled by a slide damper. The oven was designed very carefully for a low velocity of the gases and particular attention was paid to the production of all tie rods, castings and other metal parts where they might be acted upon by the gases. The entire structure is very substantially tied together by means of steel channels and rods so as to prevent expansion cracks. The roof consists of brick arches sprung between steel channels and I-beams. The tracks carrying the trolleys are made of steel channels bolted to the steel structure of the roof and projected beyond the oven. All of the flues below the oven are lined with fire brick and the oven so designed that all of the fire brick work can be renewed without disturbing the red brick. Dry plugs are inserted at the end of the main flues for cleaning purposes. As can be seen from the photographs the oven presents a very handsome appearance and is a noteworthy advance in the art of core oven building. This same company has just completed a core oven at Syracuse, N. Y., for the Syracuse Aluminum & Bronze Co., which is practically the largest single core oven in an aluminum foundry in the

United States. It is 16 feet long, 11 feet 6 inches wide, and 8 feet 6 inches high on the inside and contains one car 15 feet long, 11 feet wide and 8 feet high.

F. A. Coleman, engineer for the J. D. Smith Foundry Supply Co., is making a specialty of the designing of core oven equipment to meet all classes of work.

WADSWORTH POWER DRIVEN CORE MACHINE.

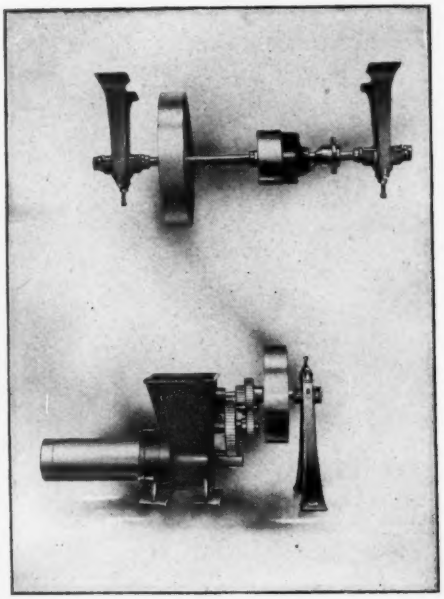
Elsewhere in this issue we publish a paper read before the Philadelphia Foundry Foremen's Association by W. O. Steele, in which he tells of a method by which he equipped a Wadsworth core machine with power attachment. The



MACHINE GEARED FOR SLOW SPEED FOR LARGE CORES.

editor of THE FOUNDRY submitted Mr. Steele's paper to Mr. Geo. H. Wadsworth, superintendent of the Falls Rivet & Machine Co., Cuyahoga Falls, O., and in reply obtained the following description of the method by which Mr. Wadsworth had accomplished the same results.

As originally designed, the Wadsworth core machine was intended to be operated by hand. When first equipped for power purposes a pulley was placed on the spindle and when it was necessary to change from one speed to another it was necessary to change the position of the pulley. This altered the length of the belt, which was an inconvenience. The reason for keeping the driving pulley on one of the stud gear shafts was to avoid the use of an extra long vent wire and a long hollow spindle. An ob-



MACHINE GEARED FOR FAST SPEED FOR SMALL CORES.

jection to the use of any device which would require an outboard bearing is found in the fact that when the outboard bearing is used the hand attachment becomes inoperative and it is impossible to make small cores by hand with the machine.

The device brought out by Mr. Wadsworth is illustrated in the two accompanying illustrations, which show how the machine may be driven at two different speeds. An ordinary countershaft with friction clutch is used with an extra wide pulley on the countershaft. To shift this change gear from the position occupied by the fast speed to that occupied by the slow speed it is necessary to move both gear and pulley a

distance slightly greater than the face width of the gear. This distance, however, is so slight that the wide face of the belt pulley on the countershaft takes care of any variation in the position of the belt. The device shown is strictly a power machine. One of the illustrations shows it arranged for high-speed for small cores and the other for slow speed employed in making large cores. The placing of the pulley on one of the gear shafts does away with the necessity of using a long vent wire and simply the ordinary standard vent wires are used. The outboard bearing is provided by using a standard hanger. Machines of this type are already in operation in several places and are giving perfect satisfaction.

A NEW IDEA IN RIDDLES.

"The Rockwell" is the name of a new riddle which has been placed on the market by the S. Obermayer Co., with factories at Cincinnati, Chicago and Pittsburg.

From present indications this riddle will prove a boon to foundrymen, as it is much stronger and has greater wear-

THE ROCKWELL RIDDLE.

ing qualities than any riddle heretofore placed before the foundry trade.

The main point of the riddle is that where the rims and liners lap, a strip of galvanized iron is bound securely over them which prevents these joints catching and thus breaking when coming in contact with other objects.

Patent on this riddle has been applied for and the Obermayer Co. will be only too glad to send full descriptive circulars of "The Rockwell" and reading matter on request.

A NEW FLASK CLAMP.

Under this heading we published an article in the November issue of THE FOUNDRY, descriptive of a clamp the action of which was illustrated by four

A NEW FLASK CLAMP.

views, one of which is reproduced herewith. In the article referred to the clamp was credited to the J. W. Paxson Co., when it should have been credited to the Tabor Mfg. Co., as it was developed in connection with the Tabor roll-over molding machine which was described in a recent issue of THE FOUNDRY. We are also informed by Mr. Wilfred Lewis, president of the Tabor Mfg. Co., that the later machines of the roll-over type have certain features which increase the efficiency of the machine and overcome many of the difficulties inherent in those first produced.

The R. J. Schwab & Sons Co., Milwaukee, is making additions to its plant for the manufacture of cement building block machines. The buildings will be of reinforced concrete construction.

MECHANICAL TIME RECORDERS.

To fill the continued and increasing demand for an instrument which makes a graphic record of variations and the time of such variations, of mechanical movements, the Bristol company, Waterbury, Conn., have placed on the market the instrument illustrated in Fig. 1 to which they have given the name Mechanical Time Recorder. A circular chart revolves by clock work at uniform speed, while the pen moves an amount proportional to the motion to be recorded.

FIG. 1.

The chart is 8 inches in diameter, being the same size as on the well known Standard Bristol Gauges.

Clock movements can be supplied for complete revolution of chart once in 15 minutes, 1 hour, 2 hours, 3 hours, 4 hours, 6 hours, 8 hours, 10 hours, 12 hours, 24 hours or 7 days. Thus it will be seen that the speed may be selected to give best results under all commercial requirements.

The pen arm is rigidly attached at its lower end to a shaft which is turned by a short arm projecting through a slot in bottom of the case.

The lever shown in the cut projecting to the right, is clamped to the short arm by a thumb nut. Special attention is called to the fact that this lever is adjustable and can be clamped to the arm at any convenient angle.

The motion to be recorded after being properly reduced, if necessary, is imparted to the lever which in turn transmits it to pen.

The total scale on the chart is usually taken proportional to the total motion to be recorded. Reduced motion if necessary, can easily be arranged by the aid of pulleys, levers or other reducing devices.

Fine adjustments can readily be made by applying the motion at the proper point along the lever, and to facilitate this, a metal attachment is provided, which is adjustable on the lever arm, and secured in any position by thumb nut. It will readily be seen that by the aid of the adjustable lever arm and the adjustable slide on the arm XX the instrument is most conveniently adapted to record motions of all amounts and directions.

Total deflection of the pen is obtained by turning the lever through an angle of about 12 degrees or 5" motion at its outer end.

This instrument can be used to record the rate of motion and position of sluice gates, turbine or engine governors, gate valves, etc. It is also adapted for recording the rise and fall of liquids in tanks, rivers, reservoirs and for bays.

In the gas industry it can be used to check up the operators and thus prevent the "blowing" of the holders either day or night. Its applications are, however, so many and varied that it is difficult to mention them even for a single industry.

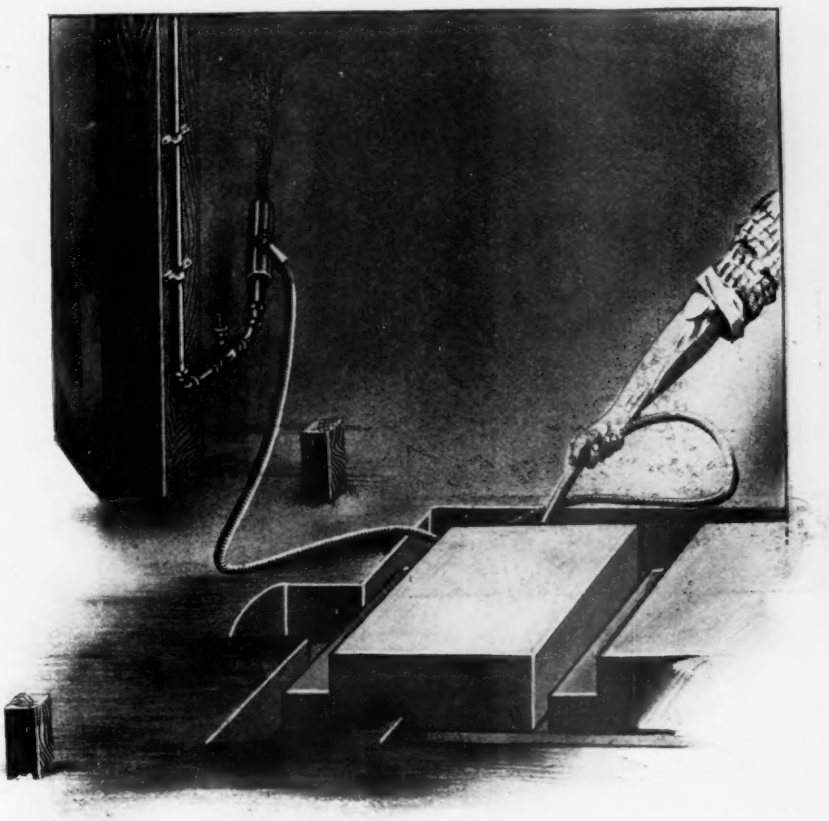
PNEUMATIC SUCTION APPARATUS.

All molders have had a great deal of trouble in clearing out sand or dirt from deep boxes or narrow spaces, particularly in dry sand or skin dried molds and will welcome anything which will enable them to clean this

out quickly and easily. This is particularly true in the case of large molds in which a number of cores have been set. An appliance for accomplishing this is shown in the accompanying illustration and it consists of an apparatus operated by compressed air at 80 pounds pressure. To this is attached a length of hose which will enable the operator to reach any part of the mold. The rush of air through the ejector sucks the sand from the mold through the hose and discharges it as shown. A device of this kind has long been needed and will be found an exceedingly valuable addition to any foundry equipment. The device illustrated is manufactured by the J. W. Paxson Co., of Philadelphia, Pa.

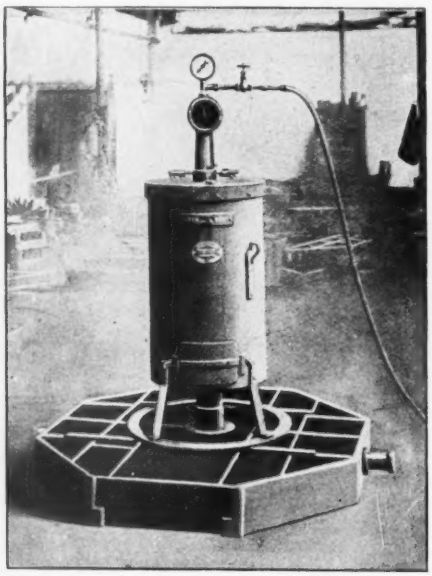
A MOLD DRYING APPARATUS.

Many attempts have been made to produce suitable mold drying apparatus for use in ordinary foundries, but their introduction in American foundry practice has been rather slow, largely on account of the fact that most types thus far developed have been very heavy affairs, which had to be moved about with a crane. The apparatus shown in the accompanying illustration is made of such a size and weight that it can easily be moved from place to place by two men. The outer cylindrical casing contains an inner fireplace and compressed air is furnished from an air hose at the top as shown. The air hose requires air at about 20 pounds pressure and comsumes 10 cubic feet per minute. The



PNEUMATIC SUCTION APPARATUS FOR CLEANING MOLDS.

inner fireplace is lined with fireclay and is arranged with a flat hearth for supporting the coke, which may be either gas house coke or refuse coke. When the air is turned on a portion of it passes down through the fire while the balance of it passes through an adjustable ring down between the fireplace and the outer shell. The cold air and the air passing through the fire, together with the products of combustion, are mingled in the space



A MOLD DRYING APPARATUS.

below the fireplace. The openings in the ring for controlling the amount of air passing down around the fireplace are regulated by a small lever shown above the name plate in the front of the casing.

By regulating the amount of air passing about the fireplace, the temperature of the hot air and gases which enter the mold can be regulated so as to prevent burning of the mold. The flowing of the cold air down between the fireplace and the outer casing serves a double purpose. First, it keeps the apparatus cool enough so that it can be handled readily by workmen, and second, it serves to economize heat by carrying all of the waste heat which would otherwise be radiated from the fireplace down into the mold. In other words, this apparatus is not only under control, but is exceedingly efficient, in that it utilizes practically all the heat of the fuel.

Another advantage is that the air passes downward through the fire, thus passing through the fresh fuel, first. This results in the complete burning of the fuel, including all of the products of combustion.

The makers advise feeding the fire with live coke, but state that dead or cold coke can be used if only a small amount is used at one time.

This device is manufactured by the Tilghman - Brooksbank Sand Blast Co., 1126 South Eleventh St., Philadelphia, Pa.

THE THOMES CORE BOX MACHINE.

The Thomes core box machine, manufactured by the Portland Co., Portland, Me., is shown in the accompanying illustration. This machine is simple and accurate and has been designed to cut core boxes of unusual shapes, two of which are shown in the

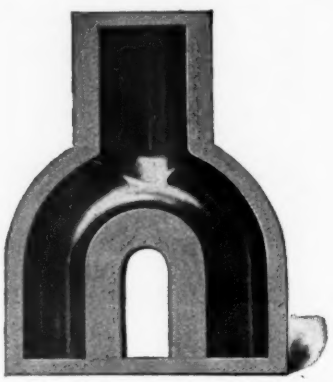


FIG. 3.—CORE BOX MADE ON THOMES MACHINE.

accompanying illustrations. The machine consists of a heavy box section, surmounted by a stationary table. The cutter-head is driven by belt from a countershaft attached to the bed. The table is maintained constantly at the same height, the

cutter-head being raised and lowered, as desired, by turning a hand-wheel within easy reach of the operator. A short time only is required to adjust the machine for the most difficult class of work.

consequently, no oval core boxes. There is no raising of the table on large work, when convenience requires that the table should be in its lowest position. The tool will cut an irregular curve without any change of

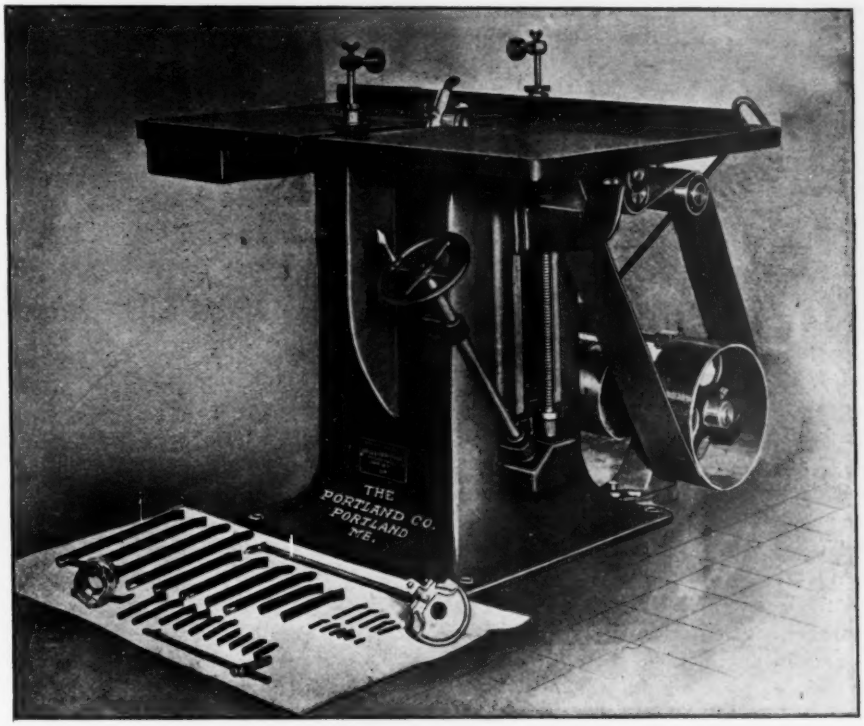


FIG. 1.—THE THOMES CORE BOX MACHINE.

The tool equipment consists of three cutter-heads, a gauge for setting cutters, the necessary cutters for making boxes from ¾ to 24 inches in diameter, wrenches, etc.

The following advantages are claimed by the manufacturer for this machine: There is no inclined shaft,

radius, and will cut hemispherical core boxes for globe or angle valves with extensions of any size in any direction. It will also cut crosses, offsets, bends, Y's, each in one piece, and will do smooth work on the cheapest class of stock. The cutter-heads can be changed in a few seconds, and

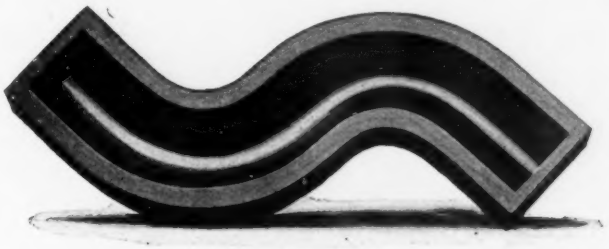


FIG. 2.—CORE BOX MADE ON THOMES MACHINE.

there is only one hand-wheel to operate.

As an example of the work which this tool will do, the core box shown in Fig. 2, having a diameter of core of six inches and a length of cut 48 inches was sawed from a plank and completely finished, except painting, in 1½ hours. The core box shown in Fig. 3, having a diameter at the large end of four inches and at the circular part of 3½ inches and a length of cut of 30 inches was made in 45 minutes.

TRADE NOTES.

The Robert Field Co., Cincinnati, has been incorporated with an authorized capital of $100,000, to succeed the Robert Field Sales Agency, which was a partnership formed by A. A. Field and J. C. Layne Jr., the agency being under the management of Robert Field. The officers of the new company, all of whom have been associated with the Robert Field Sales Agency, are as follows: Robert Field, president; J. C. Layne, Jr., vice president; N. H. Ashley, vice president; Herbert Black, secretary and treasurer. The company will continue to act as agent for all the furnaces heretofore represented and will conduct its business on a larger scale than formerly.

The Cleveland Fillet Co., Cleveland, announces that it is now carrying a full line of patternmakers' supplies in addition to its wood and leather fillets.

The Hill & Griffith Co., Cincinnati, O., has opened an office and warehouse at 2012 Avenue A South, Birmingham, Ala., with D. N. Hill as resident manager, and will carry a full line of foundry facings, supplies and equipment for its rapidly increasing southern trade.

The Dayton Pneumatic Tool Co., Dayton, O., on October 16 elected the following directors: Wm. W. Price, David O. Holbrook, R. E. Condit, G. L. Wagner and F. W. Buchanan. Wm. W. Price was elected president and treasurer; David O. Holbrook, vice president, and F W. Buchanan, secretary and general manager. The company reports such a growing demand for the Dayton hammer that it has been obliged during the past six months to double the capacity of its plant and is now in a position to make prompt delivery on orders for any of its various tools.

Chas. K. Cooper, for sixteen years chief engineer of the Mutual Life Co.'s buildings, has resigned and is now associated with the American Air Compressor Works, 26 Cortlandt street, New York city, as consulting engineer.

The Whiting Foundry Equipment Co., Harvey, Ill. has increased its capital stock from $400,000 to $700,000 and the number of its directors from three to five.

The Dings Electro-Magnetic Separator Co., of Milwaukee, Wis., has recently made substantial additions to its factory and installed considerable new equipment. This has been made necessary by the steady increase in orders which have been received during the last few months.

The Ransom Mfg. Co., of Oshkosh, Wis., informs us that it has recently had to purchase additional equipment to enable it to fill its orders for Vulcan grinding and polishing machinery.

To meet the increasing demand for its Franklin compressors, the Chicago Pneumatic Tool Co., is adding 150 feet to the machine shop at its Franklin plant, which will increase its capacity from 55 to 70 compressors per month. Extensive improvements and additions were recently made to this plant.

The plant of the Western Foundry Supply Co., East St. Louis, Ill., was entirely destroyed by fire October 16, but arrangements were immediately made to obtain material from some friends in the east, so that practically no delay was experienced in filling orders. Temporary quarters were secured at once and the building of a new plant commenced immediately. Within 60 days of the fire the company reports that it hopes to be grinding in its own mill.

The Chicago Milling Co., has been organized at Riverdale, Ill., a suburb of Chicago, by W. G. Andrews, George A. Hubbard and J. F. Wallach, for the manufacture of foundry flour. Four separate grades will be placed on the market under the following names. "H. A. W," "Chimco," "Koro," and "Usona." The many years' experience which Messrs. Andrews and Hubbard have had in the manufacture and sale of foundry flour insures the success of their new departure. The plant at present has a capacity of three cars per day, which will be materially increased when the improvements and extensions now under way are completed.

H. Van Atta, for the past fifteen years superintendent of the J. L. Mott Iron Works, Mott Haven, N. Y., has joined the organization of Geo. K. Hooper, mechanical engineer, 11 Broadway, New York. Mr. Van Atta is a graduate of the Stevens Institute of Technology, class of '81, and has since devoted his time to manufacturing industries. He is also thoroughly familiar with the cost of production and the most approved methods of obtaining information on this important subject. Mr. Hooper has a well established reputation as a consulting engineer and the addition of Mr. Van Atta to his staff will enable him to handle any problems relating to manufacturing industries, especially in foundry operations.

PERSONALS.

W. H. Hayes has resigned as superintendent of the Foster Stove Works, Ironton, O., to enter manufacturing on his own account. He has been succeeded by Harry Beals.

Leonard Eyke, for some time officially connected with the Pratt Malleable Iron Works, Joliet, Ill., has resigned to take the superintendency of the Terre Haute Malleable Iron Works, Terre Haute, Ind.

N. V. F. Wilson, retiring general manager of the Portsmouth Steel Co, Portsmouth, O., has removed to Pittsburg. He was presented with a handsome gold watch by the employes of the company.

Charles A. Maher, secretary of the National Car Wheel Co. since its incorporation, has been elected a vice president. James D. Rhodes, Pittsburg, has been re-elected president, William F. Bonnell, Cleveland, a vice president, and George P. Rhodes, Pittsburg, has been made secretary and treasurer.

J. P. Houston has taken up his new duties as general manager of the Portsmouth Steel Co., Portsmouth, O.

Prof. H. M. Howe, of Columbia University, has received from the czar the order of the knighthood of St. Stanislaus in acknowledgement of his work in metallurgical research. The honor was conferred by Baron Rosen, who presented the patent of knighthood and also the star and cross of the order.

The business associates of Chas A. McNair, president of the St. Louis Blast Furnace Co., presented him with a beautiful loving cup on the occasion of his 75th birthday on Nov. 2. Mr. McNair has been engaged in the smelting business in St. Louis for nearly forty years. The St. Louis Blast Furnace Co., for which the De Camp Bros. & Yule Iron, Coal & Coke Co., of St. Louis, is exclusive agent, has been organized since 1900.

C. R. McGohey, for the past two years superintendent of the Lombard Iron Works, Augusta, Ga., has resigned to become general superintendent of the E. Van Winkle Machine Co., Atlanta, Ga.

W. G. Keller, formerly with the Southwark Scale Co., of Camden, N. J., has been made assistant superintendent of the Philadelphia Stove & Iron Foundry Co., Philadelphia.

F. W. McKee, secretary and treasurer of the Beaumont Iron Works, Beaumont, Texas, has resigned and will return to the H. W. Middleton Co., Philadelphia, which he left three years ago. C. A. Ganoung will succeed him both as secretary and treasurer and as a director.

T. S. Penny, manager of the Aetna Foundry & Machine Co., Warren, O., has resigned and taken a position at Ford City, Pa.

J. W. Duntley, president of the Chicago Pneumatic Tool Co., sailed for Europe Nov. 6 for a five weeks' trip

in the interest of the company's business.

E. L. Binns has taken charge of the foundry department of the American Seeding Machine Co., Superior division, Springfield, O.

William Curtin has been made foreman of the foundry of the Wickham Piano Plate Co., Springfield, O.

E. W. Cadwell, who has been foundry superintendent for the Samuel C. Tatum Co., of Cincinnati, has resigned to accept a similar position with the Peerless Foundry Co., Hamilton, O.

DEATHS.

David Smart, for more than 55 years a resident of Chillicothe, O., died in that city Oct. 28, at the age of 80, death being due to heart trouble. Mr. Smart was for several years mayor of Chillicothe. He was formerly connected with Richland furnace in Vinton county, for several years serving as its treasurer, and with the old Chillicothe foundry. His father was one of the early blast furnace. superintendents of western Pennsylvania. He is survived by a widow, a daughter, Miss Mary, and a son, George, who is editor of *The Iron Trade Review*.

William B. Earnshaw, president of the Dayton Malleable Iron Co., and one of the most prominent men of Dayton, O., both in social and business life, died of heart failure Oct. 31, while a guest at the International Hotel, Sault Ste. Marie, Ontario. Mr. Earnshaw was graduated from the Central high school of Dayton with high honors and later from the Miami commercial college. He soon after entered the employ of the Dayton Malleable Iron Co., and was rapidly promoted, first to the position of secretary and later to that of vice president and general manager. In 1902, Robert C. Schenck, president of the company, died and Mr. Earnshaw was elected to the presidency.

Lewis Henry Davies, secretary and treasurer of the Lewis Foundry & Machine Co., Pittsburg, died Oct. 21, a few hours after being caught by runaway street cars. Although but 30 years of age, Mr. Davies had come to occupy a prominent place in the foundry industry of Pittsburg.

George D. Dana, founder, vice president and general manager of the Charter Oak Stove & Range Co., St. Louis, died Oct. 16 at his suburban home near that city. He was born in Cincinnati in 1845, graduating from Washington University and locating in St. Louis, where he has been in the stove manufacturing business for 45 years.

John Stuber, died Oct. 14 at his home in Cleveland, O., aged 67. He was born in Germany, coming to America in 1866, and locating in Cleveland. He was one of the organizers of the Standard Foundry & Mfg. Co., of Cleveland, holding the position of superintendent until about ten years ago, when he resigned to accept a similar place with the Ohio Foundry Co.

George Augustus Crocker, senior member of the firm of Crocker Bros., dealers in pig iron and importers of ferro-manganese, at 70-99 John street, New York, died on Oct. 21, at the age of 75. Mr. Crocker was educated at Brown University and soon after formed the firm of Crocker Bros. About five years ago he retired from active business, but visited the offices regularly until a few months ago. He was ill for many weeks, the immediate cause of death being heart failure. Mr. Crocker was a director of the Bank of America and held other positions of trust. He is survived by his wife and three children.

FIRES.

The H. W. Caldwell & Sons Co., Chicago, states that the fire of Oct. 15, which caused about $35,000 loss to its plant, left the walls of the building intact and the cupola, blower and large crane unharmed. Arrangements were made for taking care of immediate needs in castings, and the company will soon be molding on its own floor.

The brass foundry of George W.

Hayden, Cambridge, Mass., burned Oct. 26.

The Lorenna Foundry Co., Bridgeport, Pa., recently lost its core building by fire.

The buildings of the Dyment Foundry Co., Barrie, Ont., with the exception of the molding shop, were destroyed by fire Oct. 28.

The Grand Rapids Malleable Iron Works, Grand Rapids, Mich., owned by the Chicago Railway Appliance Co., burned recently with a loss of about $100,000, fully insured. It is reported that the plant will be rebuilt.

The old Union Foundry building, on University avenue, Rochester, N. Y., was partly destroyed by fire on Oct. 9, with a loss of $5,000.

The Union foundry in Ayer City, near Lowell, Mass., was damaged by fire on Oct. 18 to the extent of $3,000, fully insured.

A mysterious fire at the King's foundry, Coshocton, O., Oct. 7, caused a loss of $1,000.

Fire at the Co-operative foundry, Nashua, N. H., on Oct. 30, caused a loss of $1,000.

The plant of the Carnegie Plow & Mfg. Co., Carnegie, Pa., was destroyed by fire on Nov. 2, with a loss of $125,000, partly covered by insurance. It is said the plant will be rebuilt at once.

NEW CONSTRUCTION.

The Hersey Mfg. Co., South Boston, Mass., will equip a brass foundry on the top floor of its new factory for manufacturing water meters.

Clayton Bros., Bristol, Conn., have practically completed their new iron foundry.

The Libby Mfg. Co. is erecting a foundry at Niantic, Conn., for the manufacture of brass goods, plumbers' supplies, and similar articles.

The Russell & Erwin Mfg. Co., New Britain, Conn., is to extend its plant by the addition of a brick structure, 84 x 130 feet.

The Contractors' Castings & Machine Co., Buffalo, recently incorporated, will erect a foundry and machine shop on Hertel avenue, at a cost of $25,000.

The Empire Foundry Co., Syracuse, N. Y., will erect a new plant, and plans have been prepared for a building 80 feet long.

The York Mfg. Co., York, Pa., manufacturer of ice-making and refrigerating machinery, is making additions to its foundry and pipe shop.

The National Foundry Co., Erie, Pa., is building a steel casting plant of special design. F. Felkel is consulting engineer.

The Wm. Cramp & Sons Ship & Engine Building Co., Philadelphia, is erecting several additions to its foundry.

The Ball Engine Works, Erie, Pa., are having plans and specifications prepared by the Osborn Engineering Co., of Cleveland, for a large foundry.

The Pittsburg Automatic Machine Co. has purchased a tract of land in Ellwood City, Pa., upon which it will erect a malleable castings plant to employ 100 men.

The Fort Pitt Malleable Iron Co., Pittsburg, is planning the erection of large additions to its plant at McKees Rocks, Pa., which include a 15-ton open-hearth furnace, an addition to the main foundry and the enlargement of its annealing department.

An iron foundry, 50 x 100 feet, is to be erected at Wrightsville, Pa., by H. K. Smith and C. W. Schultz, formerly connected with the Susquehanna Casting Co., and H. B. Kerr.

The Federal Machinery Co., Allegheny, Pa., and the Republic Engineering Co., Pittsburg, have been merged and will henceforth be known as the Republic Engineering & Mfg. Co., with general offices in Allegheny. The capital of the new company is $75,000. Special mill machinery will be manufactured and general casting and machine work done. A new brass foundry and pattern shop are under construction and will probably be completed by Dec. 1.

The Foster Bros. Mfg. Co., St. Louis, Mo., is to erect a fireproof foundry building in that city to cost $11,000.

The New Phoenix Foundry & Machine Co., Springfield, Mo., is now operating its new plant.

It is expected that the valve manufacturing plant which is to be constructed at St. Henri, Montreal, by Jenkins Bros., Ltd., of New York, will be in operation by next April, employing at least 300 men. The plant includes a main building, 50 x 200 feet, foundry building, 64 x 150 feet, engine and boiler house, etc., and it is probable that a second foundry, 60 x 100 feet, will be built later.

The Pittsburg Valve & Fittings Co., Pittsburg, has completed a new foundry, 160 x 360 feet, for malleable castings, equipped with two 35-ton air furnaces and 70 air-driven molding machines. This completes the company's series of foundries and gives it the following capacities: Gray iron, 40 tons daily; brass, four tons daily; malleable iron, 25 tons daily.

The Reading Radiator Co., Reading, Pa., is to erect an addition to its foundry, 60 x 90 feet.

The Peerless Foundry Co., Hamilton, O., is building an addition, 70 x 200 feet.

W. B. Wright is building a new foundry, 40 x 80 feet, at Hubbard, O., which will be known as the Hubbard foundry.

Work on the addition to the Spence-Baggs stove foundry, at Martins Ferry, O., is progressing rapidly.

The Stirling Boiler Co., Barberton, O., will begin operations in its new foundry with a greatly increased force.

The Duplex Foundry, Elyria, O., whose plant was recently damaged by fire, has repaired its plant and is planning to build a machine shop, 50 x 80 feet, and a foundry 50 x 100 feet.

The Ralston Steel Car Co., Columbus, O., is preparing plans for a new malleable castings plant in connection with its shops.

The East Liverpool Foundry, Machine & Supply Co., East Liverpool, O., has awarded the contract for the erection of a new foundry and machine shop. All the necessary machinery has been contracted for.

The Bullock electric plant of the Allis-Chalmers Co., Norwood, Cincinnati, O., is to be improved and its capacity considerably increased.

The Buckeye Steel Castings Co., Columbus, O., is planning to extend its main building 100 feet and another building 150 feet.

Francis M. McGinty, of Alliance, O., is at the head of a new company which is shortly to be incorporated for the purpose of establishing a steel casting plant at Alliance, O. The main building will be 76 x 254 feet, and will be equipped with a 20-ton open-hearth furnace. Mr. McGinty announces that he has purchased a ten-acre tract for the works.

The Hamilton Foundry & Machine Co., Hamilton, O., will double the capacity of its plant. A foundry, 60 x 386 feet will be erected and considerable new machinery added. A power plant is also being erected.

The Silver Mfg. Co., Salem, O., is erecting an addition to its foundry and installing a new cupola.

The Ashtabula Foundry Co., Ashtabula, O., is increasing its plant by the erection of a molding shop 84 x 130 feet.

The Lattimer-Williams Co., Columbus, O., has prepared plans for a stove foundry 45 x 280 feet.

The Monarch Iron Works Co., Plymouth, Ind., recently incorporated with a capitalization of $50,000, is now occupying its new plant. The foundry is 72 x 140 feet and machine shop, pattern shop and office building are being erected. Foundry work is being done under contract. E. S. Tascher is manager of the plant.

The plant of the Malleable Iron Works, Terre Haute, Ind., is to be larger than was originally planned. Contracts have recently been let for one building and will soon be placed for another.

WE **SOLD** OVER

45,000

Barrels Flour

in the past twelve months

Some one must be satisfied with the flour which they are getting, as well as the treatment accorded them, or we could not have done this amount of business.

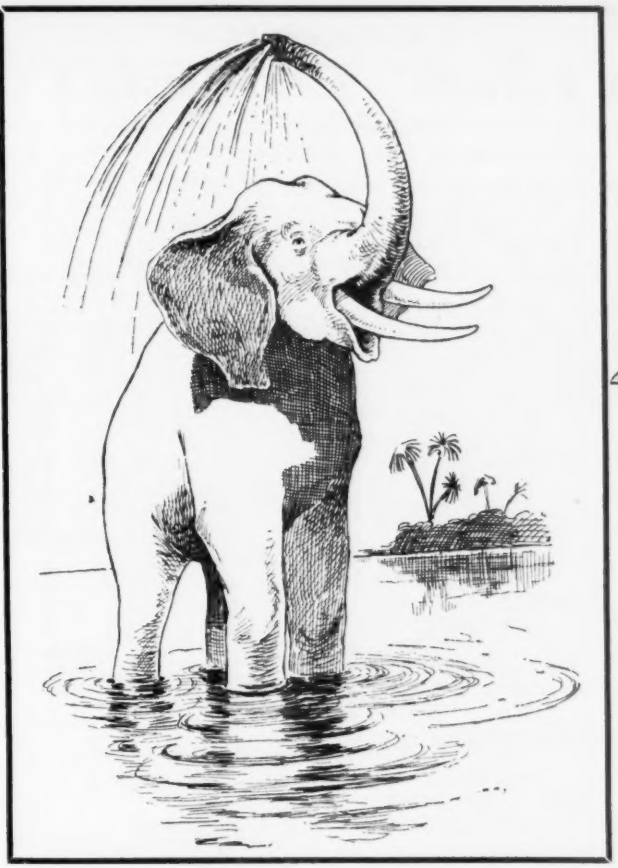
We are pleased to announce that we are now in shape to do double the amount of the above business in the future, as we have largely increased the capacity of our plant.

The Piqua Flour Co.

PIQUA, OHIO, U. S. A.

Alphabetical Index to Advertisers.

Adams Co. 16, 147
Addy, Matthew, & Co. 158
Ajax Metal Co. 152
American Air Compressor Works. 154
American Blower Co. 34
Arcade Mfg. Co. 20
Atlanta Pattern Mfg. Co. 154
Atlas Car & Mfg. Co. 141
Baird & West 159
Barnett, Oscar, Foundry Co. 39
Bartlett, N. S., & Co. 158
Basic Chemical Co. 151
Berkshire Mfg. Co. 17
Blackwell, Geo. G., Sons & Co. 153
*Blake, Geo. F., Mfg. Co. ..... —
Brass Founders' Supply Co. 142
Bridgeport Safety Emery Wheel Co. 135
Bristol Co. 156
Brown Specialty Machinery Co. 24
Burdick & Son. 142
*Byram & Co. ..... —
Carborundum Co. 133
Case Mfg. Co. 140
Cherry Valley Iron Co. 40
Chicago Pneumatic Tool Co. 30
Clark Cast Steel Cement Co. 26
*Cleveland Fillet Co. ..... —
Columbus Iron & Steel Co. 158
Connersville Blower Co. ..... Back cover
Cornell, J. B. & J. M., Co. 148
Crescent Phosphorized Metal Co. 152
Curtis & Co. Mfg. Co. 37
Dalton, Nash & Co. 158
*Deane Steam Pump Co 150
DeCamp Bros. & Yule Iron, Coal & Coke Co. 158
Detroit Testing Laboratory 154
Diamond Clamp & Flask Co. 147
Dimmick, J. K., & Co. 158
Dings Electro Magnetic Separator Co. 146
Dixon, Joseph, Crucible Co. 36
Dobson, William. 157
Dodge & Day 156
Doggett, Stanley 145
Domhoff & Joyce Co. 158
Drucklieb, C. 133
Elliot, Debevoise & Anderson 159
Elm City Engineering Co. 146
Etting, Edward J. 155
Falls Rivet & Machine Co. 23
Field, Alfred & Co. 151
Field, Robt., Sales Agency. 159
Fox Machine Co. 155
Gautier, J. H., & Co. 42, 154
General Chemical Company. 154
General Pneumatic Tool Co. 139
Gilmour, J. 142
Goldschmidt Thermit Co. 143
Goodrich, F. A., & Co. 158
Gregg Company 140
Gunn, Richards & Co 127
Hanna Engineering Works. 28
Harbison-Walker Refractories Co. 157
Harrington Son & Co., Edwin. 139
Hawley Down Draft Furnace Co 46
Herman Pneumatic Machine Co. 18
Hill & Griffith Co. 5
Hillman, J. H., & Son. 158
Hooper, G. K. 156
Independent Pneumatic Tool Co. 136
Ingersoll-Rand Co 31
Jones & Attwood. 151
Joy Detective Service 156
Keep, W. J 154
Kendall & Flick 152
*Kent Mfg. Co. ..... —
Library Bureau. 129
Lindsay, W. W., & Co. 21
Loughry, James C. 135
MacKellar's Sons Co. 147
Manning, Maxwell & Moore. 138
Maris Bros. 137
Maurer, Henry & Son. 157
Maywood Foundry & Machine Co. 19
McCormick, J. S., Co. 8
McCullough-Dalzell Crucible Co. 44
McKeefrey & Co. 158
Metallurgical Laboratory. 154
Mfg. Equipment and Engineering Co. 130
Midvale Mining & Mfg. Co. 148
Millett Core Oven Co. 22
Mills, C. E., Oil Co. 38
Mohr, J. J. & Son. 158
Monarch Engineering & Mfg. Co. 47
Mumford, E. H. Co. 12, 13
National Jeloluse Co. 151
New Era Mfg. Co. 153
Niles-Bement-Pond Co. 140
Northern Engineering Works 137, 138
Norton Company 131
Norwalk Iron Works Co. 146
Obermayer, S., Co. ..... Inside front cover
Osborn Mfg. Co. 136
Otis Steel Co. 147
Pangborn, T. W. Co. 9
Pawling & Harnischfeger. 139
Paxson, J. W., Co. 2, 3, 4
*Pettinos Bros. ..... —
Phosphor Bronze Smelting Co. 152
Pickands, Brown & Co. 159
Pickands, Mather & Co. 159
Pilling & Crane 159
Piqua Blower Co. 149
Piqua Flour Co. 121
Pridmore, Henry E. 10, 11
Ransom Mfg. Co. 133
Rathbone, John A. 13
Ridgway, Craig, & Son Co. 32
Robeson Process Co. 1
Rockwell Engineering Co. 143
Roessler & Hasslacher Chemical Co. 153
Rogers, Brown & Co. 159, 160
Roots, P. H. & F. M., Co. ..... Insert
Ross-Tacony Crucible Co 45
Seidel, R. B. Inc. 150
Sellers, Wm., & Co. 41
Shanafelt Mfg Co. 25
Shelton Metallic Filler Co. 29
Shepard, Chas. G. 159
Shuster, F. B., Co. 148
Sly, W. W., Mfg. Co. 33
Smith, J. D., Foundry Supply Co. 6, 7
Smooth-On Mfg. Co 27
Standard Sand & Machine Co. 145
Sterling Oil Co. 151
Stevens, F. B. 123, 125, 159
Stephens & Co 149
Stow Mfg. Co. 135
Sturtevant, B. F., Co 35
St. Louis & San Francisco R. R. Co. 149
*Surplus Coke Co. 148
Tabor Mfg. Co. 14, 15
Taylor, A. L. 156
Taylor, Robert J., Inc. 43
Thomas Furnace Co. 159
Tilghman-Brooksbank Sand Blast Co. 135
Turner Machine Co. 136
U. S. Chaplet Co. 149
Walter-Wallingford & Co. 159
Watt Cupola Twyer Co. 161
Western Foundry Supply Co. 153
Whiting Foundry Equipment Co. 48
Wiener Co., Ernst. 141
Yale & Towne Mfg. Company 141



The above beautiful cut which by the way was executed by the "artist on the spot," is now my registered Trade Mark, No. 56800, Oct. 16th, 1906.

I adopted the design because the Elephant's example is worth emulation. He makes no claims to be the biggest in the world and yet is of very comfortable proportions.

He is careful not to step on anyone's toes and generally speaking, behaves himself in a most creditable manner. He is even willing to exist without the desire to crowd all others off the track, and, in all, possesses excellent qualities.

When you see the elephant sticker on my barrels of Plumbago and Foundry Facings, you may know that they embody all the same good qualities.

Incidentally---I manufacture FOUNDRY FACINGS, FOUNDRY SUPPLIES, and POLISHERS' and PLATERS' SUPPLIES.

Frederic B. Stevens

Cor. Larned & Third Sts.,

DETROIT, MICH.

CLASSIFIED

BUYERS' DIRECTORY

Advertisers' names are inserted under this heading at the rate of four classifications to each page advertisement carried regularly.

Abrasive Materials:
Carborundum Company, Niagara Falls.
Norton Company, Worcester, Mass.

Accountants.
Gunn, Richards & Co., New York.
Library Bureau, Systematizing Dept., Boston.

Air Compressors:
American Air Compressor Works, New York.
Independent Pneumatic Tool Co., Chicago.
Chicago Pneumatic Tool Co., Chicago.
Curtis & Co. Mfg. Co., St. Louis.
Independent Pneumatic Tool Co., Chicago.
Ingersoll-Rand Co., New York.
Norwalk Iron Works Co., So. Norwalk, Conn.

Alloys:
Blackwell Sons & Co., Geo., Ltd., Liverpool, Eng.
New Era Mfg. Co., Kalamazoo, Mich.
Phosphor Bronze Smelting Co., Ltd., Philadelphia.

Analysis—Mechanical:
Keep, W. J., Detroit.

Analysis—Chemical:
Detroit Testing Laboratory, Detroit.
Metallurgical Laboratory, Pittsburg.

Anchors:
Lindsay & Co., W. W., Philadelphia.

Babbitt Metal:
Ajax Metal Co., Birmingham, Ala.
New Era Mfg. Co., Kalamazoo, Mich.

Blowers:
American Blower Co., Detroit.
Connersville Blower Co., Connersville, Ind.
Cornell Co., J. B. & J. M., New York.
Monarch Engineering & Mfg. Co., Baltimore.
Paxson Co., J. W., Philadelphia.
Piqua Blower Co., Piqua, O.
Roots Company, P. H. & F. M., Connersville, Ind.
Sturtevant Co., B. F., Boston.

Blowers—Positive Pressure:
Connersville Blower Co., Connersville, Ind.
Piqua Blower Co., Piqua, O.
Roots Company, P. H. & F. M., Connersville, Ind.
Sturtevant Co., B. F., Boston.

Brushes:
Osborn Mfg. Co., Cleveland.

Buildings (Struct. Steel):
Lindsay & Co., W. W., Philadelphia.

Burners (Oil):
Monarch Engineering & Mfg. Co., Baltimore.

Carbonese:
Midvale Mining & Mfg. Co., E. St. Louis, Ill.

Castings (Steel):
Otis Steel Co., Ltd., Cleveland.

Cement (Furnace):
Dixon Crucible Co., Jos., Jersey City.
Gautier & Co., J. H., Jersey City.

Cement (Metallic):
Clark Cast Steel Cement Co., Shelton, Conn.
Shelton Metallic Filler Co., Derby, Conn.
Shanafelt Mfg. Co., Canton, O.
Smooth-On Mfg. Co., Jersey City.

Chaplets:
Burdick & Son, Albany.
Lindsay & Co., W. W., Philadelphia.
Shanafelt Mfg. Co., Canton, O.
U. S. Chaplet Co., New York.

Coke:
Rogers, Brown & Co., Cincinnati.
Surplus Coke Co., New York.

Cores:
Brown Specialty Machry. Co., Chicago.

Core Binders:
Mills Oil Co., C. E., Syracuse.
National Jeloluse Co., New York.
Robeson Process Co., Camden, N. J.
Sterling Oil Co., Emlenton, Pa.

Core Machines:
Brown Specialty Machry. Co., Chicago.
Falls Rivet & Mch. Co., Cuyahoga Falls, O.
Jones & Atwood, Stourbridge, Eng.
Kent Mfg. Co., Kent, O.

Core Tapering Machines:
Brown Specialty-Machinery Co., Chicago.

Core Ovens:
Atlas Car & Mfg. Co., Cleveland.
Falls Rivet & Mch. Co., Cuyahoga Falls, O.
Millett Core Oven Co., Brightwood, Mass.
Paxson Co., J. W., Philadelphia.
Pangborn Co., Thos. W., New York.
Smith Foundry Supply Co., J. D., Cleveland.

Core Oven Recording Thermometer:
Bristol Co., Waterbury.

Cost Keeping Systems.
Gunn, Richards & Co., New York.
Library Bureau, Systematizing Dept., Boston.
Loughry, James C., Elyria, O.

Cranes:
Case Mfg. Co., Columbus, O.
Curtis & Co. Mfg. Co., St. Louis, Ill.
Manning, Maxwell & Moore, New York.
Maris Bros., Philadelphia.
Niles-Bement Pond Co., New York.
Northern Engrng. Works, Detroit.

Continued on page 126

STEVENS SILVER FINISH

STEVENS SILVER FINISH

¶ The success of the stove making fraternity throughout this great and glorious country may be due in part to the way they dress up things with nickel plated trimmings.

¶ The beauty of any nickel plate is greatly enhanced by the use of STEVENS' SILVER FINISH. Wherever a brilliant finish is required nothing else is as good---especially where there are deep backgrounds liable to be filled, particles so left are easily washed out.

¶ It gives pocket-book satisfaction. I manufacture a complete line of Polishing and Plating Compositions. Samples sent without charge, and by express prepaid.

I manufacture also, EMERY CAKE, in which I use genuine imported TURKISH EMERY. ENGLISH CROCUS COMPOSITION made with use of imported materials. SPANISH FELT WHEELS—pure felt—Goods of quality only.

Frederic B. Stevens

Corner Larned and Third Streets

DETROIT, MICH.

CRANES—Continued.
Pawling & Harnischfeger, Milwaukee.
Ridgway & Son, Craig, Coatesville, Pa.
Sellers & Co., William, Inc., Philadelphia.
Whiting Foundry & Equipment Co., Harvey, Ill.

Crucibles:

Dixon Crucible Co., Jos., Jersey City.
Taylor, A. L., San Francisco.
Gautier & Co., J. H., Jersey City.
McCullough-Dalzell Crucible Co., Pittsburg.
Monarch Engineering & Mfg. Co., Baltimore.
Paxson Co., J. W., Philadelphia.
Ross-Tacony Crucible Co., Philadelphia.
Seidel, R. B., Inc., Philadelphia, Pa.
Taylor, Robt. J., Inc., Philadelphia.

Cupolas:

Byram & Co., Detroit.
Gilmour, J., New York.
McCormick Co., J. S., Pittsburg.
Northern Engnrng Works, Detroit.
Paxson Co., J. W., Philadelphia.
Whiting Foundry Equipment Co., Harvey, Ill.

Cupola Linings:

McCormick Co., J. S., Pittsburg.
Paxson Co., J. W., Philadelphia.

Curbing (Foundry):

United States Steel Piling Co., Chicago.

Drills:

Independent Pneumatic Tool Co., Chicago.

Elevators:

Curtis & Co. Mfg. Co., St. Louis.
Ridgway & Son, Craig, Coatesville, Pa.

Engines (Steam):

American Blower Co., Detroit.
Sturtevant Co., B. F., Boston.

Engineers (Foundry, Mech., Elec., &c.):

Dodge & Day, Philadelphia.
Hooper, Geo. K., New York City.
Lindsay & Co., W. W., Philadelphia.

Facings:

Dixon Crucible Co., Jos., Jersey City.
Doggett, Stanley, New York.
Hill & Griffith Co., Cincinnati.
R. MacKellar's Sons Co., Peekskill, N. Y.
McCormick Co., J. S., Pittsburg.
Obermayer Co., S., Cincinnati.
Paxson Co., J. W., Philadelphia.
Pettinos Bros., Bethlehem, Pa.
Smith Foundry Supply Co., J. D., Cleveland.
Stephens & Co., Kidwelly, Eng.
Stevens, F. B., Detroit.
Western Foundry Supply Co., E. St. Louis, Ill.

Fans:

American Blower Co., Detroit.

Ferro-Manganese:

Kendall & Flick, Washington, D. C.
Rogers, Brown & Co., Cincinnati.

Ferro-Silicon:

Roessler & Hasslacher Chemical Co., New York.
Rogers, Brown & Co., Cincinnati.

Fillers (Metallic):

Clark Cast Steel Cement Co., Shelton, Conn.
Shanafelt Mfg. Co., Canton, O.
Shelton Metallic Filler Co., Derby, Conn.
Smooth-On Mfg. Co., Jersey City.

Fillets:

Cleveland Fillet Co., Cleveland, O.
Shanafelt Mfg. Co., Canton, O.

Fire Brick:

Gautier & Co., J. H., Jersey City.
Harbison & Walker, Pittsburg.
Maurer & Son, Henry, New York.
Paxson Co., J. W., Philadelphia.

Fire Sand:

Carborundum Co., Niagara Falls, N. Y.

Flasks:

Adams Co., Dubuque, Ia.
Barnett Fdy. Co., Oscar, Newark.
Brass Founders' Supply Co., Newark.

Flasks (Snap):

Adams Co., Dubuque, Ia.
Diamond Clamp & Flask Co., Richmond, Ind.
Obermayer Co., S., Cincinnati.
Paxson Co., J. W., Philadelphia.

Flour:

Piqua Flour Co., Piqua, O.

Flux:

Basic Chemical Co., Evansville, Ind.

Foundry Equipment (Iron & Brass):

Barnett Fdy. Co., Oscar, Newark.
Etting, Edward J., Philadelphia.
Obermayer Co., S., Cincinnati.
Pangborn Co., Thos. W., New York.
Sly, W. W. Mfg. Co., Cleveland.
Stevens, F. B., Detroit.
Taylor, Robert J., Inc., Philadelphia.
Wiener Co., Ernest, New York.

Foundry Supplies:

A. L. Taylor, San Francisco.
Hill & Griffith Co., Cincinnati.
McCormick Co., J. S., Pittsburg.
Obermayer Co., S., Cincinnati.
Osborn Mfg. Co., Cleveland.
Pangborn Co., Thos. W., New York.
Paxson Co., J. W., Philadelphia.
Shanafelt Mfg. Co., Canton, O.
Smith Foundry Supply Co., J. D., Cleveland.
Stevens, F. B., Detroit.
Taylor, Robert J., Inc., Philadelphia.

Flux:

Basic Chemical Co., Evansville, Ind.

Furnaces (Melting):

Barnett Foundry Co., Oscar, Newark, N. J.
Hawley Down Draft Furnace Co., Chicago.
Monarch Engineering & Mfg. Co., Baltimore.
Paxson Co., J. W., Philadelphia.
Rockwell Engineering Co., New York.

Continued on page 128

The Cost of It

The expense of a modern system of cost-keeping need be no greater than a crude, antiquated and inefficient way of keeping accounts.

Such a system is accurate, quick and in ample detail, and it gives the detailed costs of every part of the work while the business is fresh—when it is most valuable as a basis of comparison.

We have studied cost-keeping very carefully and have installed systems which meet these requirements in many well-known foundries.

Will you accord us an interview?

GUNN, RICHARDS & COMPANY

Production Engineers and Public Accountants.....

43 WALL STREET, 43 EXCHANGE PLACE, NEW YORK

50 CONGRESS STREET, BOSTON

224 ST. JAMES STREET, MONTREAL

Grinding Machinery:

Adams Co., Dubuque, Ia.
Bridgeport Safety Emery Wheel Co., Bridgeport, Conn.
Norton Co., Worcester.
Ransom Mfg. Co., Oshkosh, Wis.

Grinding Wheels:

Norton Co., Worcester.

Hammers:

Independent Pneumatic Tool Co., Chicago.

Hammers (Pneumatic Chipping):

Ingersoll-Rand Co., New York.

Heating & Ventilating Apparatus:

American Blower Co., Detroit.
Sturtevant Co., B. F., Boston.

Hoists:

Curtis & Co., Mfg. Co., St. Louis.
General Pneumatic Tool Co., Montour Falls, N. Y.
Harrington Son & Co., Edwin, Philadelphia.
Niles-Bement-Pond Co., New York.
Northern Engrg. Works, Detroit.
Pawling & Harnischfeger, Milwaukee.
Sellers & Co., Inc., William, Philadelphia.
Whiting Fdy. Equipment Co., Harvey, Ill.
Yale & Towne Mfg. Co., New York.

Hoists (Pneumatic):

Ridgway & Son, Craig, Coatesville, Pa.

Hydrofluoric Acid:

General Chemical Co., Philadelphia.

Industrial Ry. Equipment:

Atlas Car & Mfg. Co., Cleveland.
The Gregg Company, Ltd., Newburg, N. Y.
Wiener Co., Ernest, New York.

Iron Ore:

Rogers, Brown & Co., Cincinnati.

Ladles:

Northern Engrg. Works, Detroit.
Smith, J. D., Foundry Supply Co., Cleveland.

Molding Machines:

Adams Co., Dubuque, Ia.
Arcade Manufacturing Co., Freeport, Ill.
Berkshire Mfg. Co., Cleveland.
Herman Pneumatic Machine Co., Zelienople, Pa.
Manning, Maxwell & Moore, New York.
Maywood Foundry & Machine Co., New York.
Mumford Co., E. H., Philadelphia.
Paxson Co., J. W., Philadelphia.
Pridmore, Henry E., Chicago.
Rathbone, John A., Detroit.
Smith, J. D., Foundry Supply Co., Cleveland.
Tabor Mfg. Co., Philadelphia.
Turner Machine Co., Philadelphia.

Pattern Letters:

Shanafelt Mfg. Co., Canton, O.

Packing (Rubber Sheet):

Smooth-On Mfg. Co., Jersey City.

Parting Materials:

Doggett, Stanley, New York.

Patterns (Metal & Wood):

Atlanta Pattern Mfg. Co., Atlanta, Ga.
Herman Pneumatic Machine Co., Zelienople, Pa.

Pattern Shop Equipment:

Fox Machine Co., Grand Rapids, Mich.

Phosphorizers:

McCullough-Dalzell Crucible Co., Pittsburg.

Phosphor Tin:

Crescent Phosphorized Metal Co., Philadelphia.
New Era Mfg. Co., Kalamazoo.

Pig Iron:

Addy & Co., Mathew, Cincinnati.
Baird & West, Detroit.
Bartlett & Co., N. S., Boston.
Cherry Valley Iron Co., Pittsburg.
Columbus Iron & Steel Co., Columbus.
Dalton, Nash & Co., New York.
De Camp Bros. & Yule, St. Louis.
Dimmick & Co., J. K., Buffalo.
Domhoff & Joyce Co., Cincinnati.
Elliott, Debevoise & Anderson, New York.
Field Sales Agency, Robert, Cincinnati.
Goodrich & Co., F. A., Detroit.
Hillman & Son, J. H., Pittsburg.
McKeefrey & Co., Leetonia, O.
Mohr, J. J., Philadelphia.
Pickands, Brown & Co., Chicago.
Pickands, Mather & Co., Cleveland.
Pilling & Crane, Philadelphia.
Rogers, Brown & Co., Cincinnati.
Shepard, Chas. G., Buffalo.
Stevens, F. B., Detroit.
Thomas Furnace Co., Milwaukee.
Walter-Wallingford & Co., Cincinnati & Pittsburg.

Plumbago:

Dixon Crucible Co., Jos., Jersey City.
Gautier & Co., J. H., Jersey City.
Hill & Griffith Co., Cincinnati.
McCullough-Dalzell Crucible Co., Pittsburg.
Obermayer Co., S., Cincinnati.
Pettinos Bros., Bethlehem, Pa.
Ross-Tacony Crucible Co., Philadelphia.
Smith, J. D., Foundry Supply Co., Cleveland.
Stevens, F. B., Detroit.

Polishers' & Platers' Supplies:

Stevens, F. B., Detroit.

Riddles:

Adams Co., Dubuque, Ia.
U. S. Chaplet Co., New York.

Sand:

Paxson Co., J. W., Philadelphia.
Pangborn Co., Thos. W., New York.
Standard Sand & Machine Co., Cleveland.
Stevens, F. B., Detroit.

Continued on page 130.